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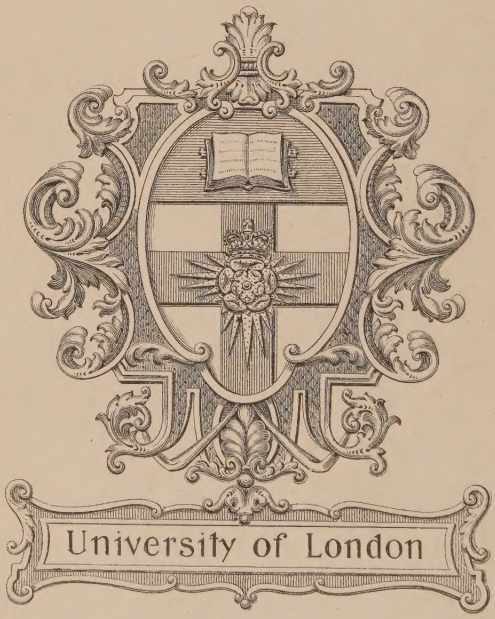
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REPORTS

FROM

COMMISSIONERS:

NINE VOLUMES.

—*(5.)*—

DEPARTMENT OF SCIENCE AND ART;
METEOROLOGICAL DEPARTMENT; MURRAIN IN CATTLE;
SEWAGE OF TOWNS.

Session

30 *April* —— 28 *August* 1857.

VOL. XX.

REPORTS FROM COMMISSIONERS:

1857—Sess. 2.

NINE VOLUMES:—CONTENTS OF THE

FIFTH VOLUME.

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FOURTH REPORT

OF THE

DEPARTMENT OF SCIENCE AND ART.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1857.

2240

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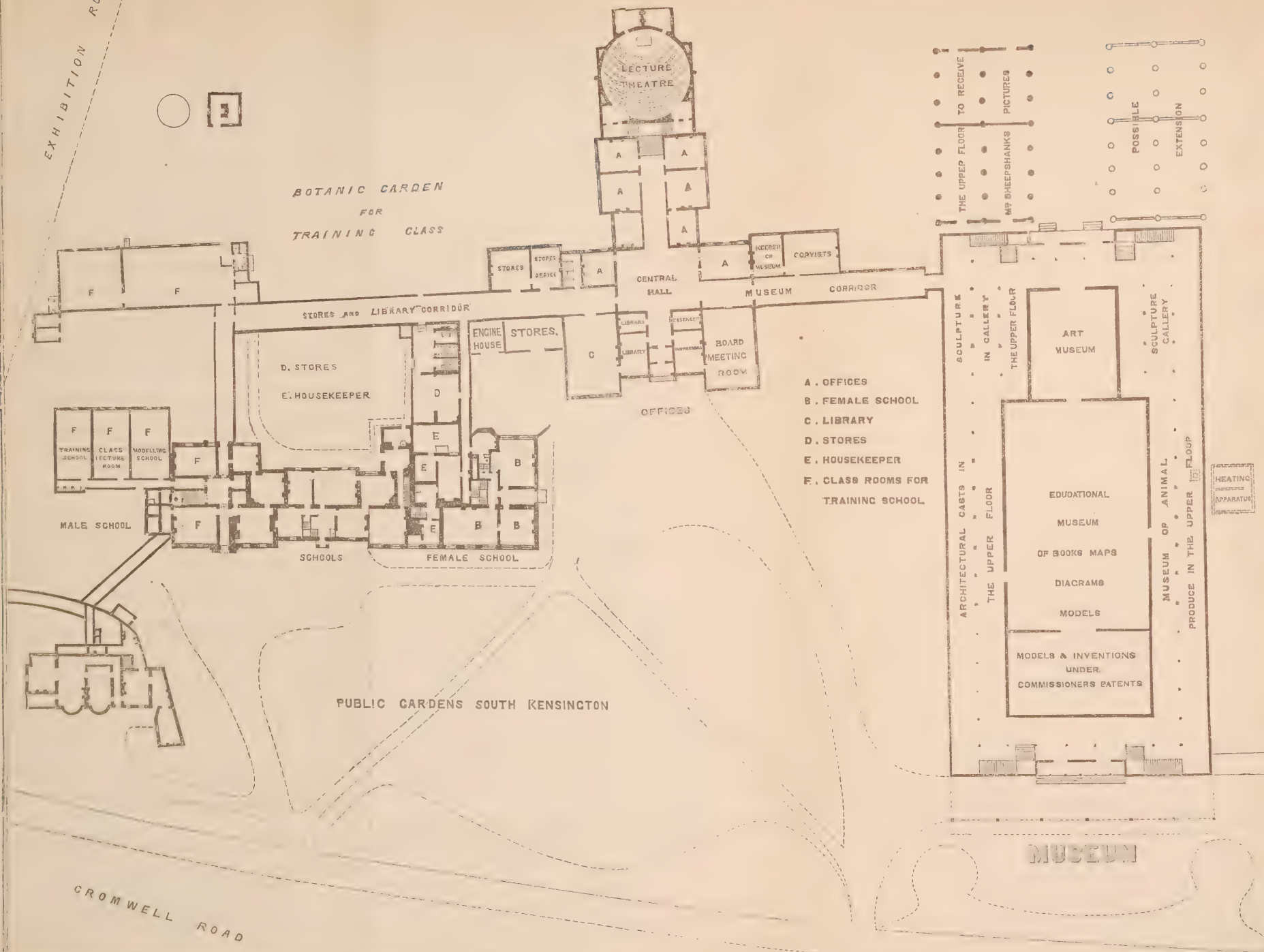

FOURTH REPORT

OF THE

DEPARTMENT OF SCIENCE AND ART.

TO THE LORDS OF THE COMMITTEE OF PRIVY COUNCIL ON EDUCATION.

My Lords, South Kensington, 25th April 1856.

Report of Secretary.

1. I have the honour to submit to your Lordships the fourth annual report of the Department of Science and Art, being that for the year ending the 31st December 1856.

Although the Department was nominally transferred from the Board of Trade to the Board of Education by an Order in Council during the past year, it continued until the present year to receive instructions from the former Board.

2. This report is divided into the following heads, with the view of bringing under consideration the various services entrusted to each separate institution.

I. Metropolitan institutions in London, Dublin, and Edinburgh.

II. Aid to schools connected with the Department, and having reference to Secondary Instruction.

III. Aid to schools not immediately connected with the Department, and having reference chiefly to Primary Instruction.

IV. Aid to schools by the formation and diffusion of examples and illustrations, as means of study.

V. Public services connected with the Department.

Report of Secretary.

I. METROPOLITAN INSTITUTIONS.

1. The Geological Survey, Mining School, Museum of Practical Geology, and Mining Record Office.

A. *The Geological Survey of the United Kingdom.*

3. The reports on the state of this service having been made up to the 31st of December, instead of, as on previous occasions, embracing the spring quarter, only nine months work is included in the present report; the results of the other three months' surveys have been already laid before Parliament. The maps which accompany the report of the Director-General (App. p. 33.) show, at a glance, the present state of the survey, and indicate the portions of the country already completed, and those which are now in progress.

Geological Survey of Great Britain.

4. During the last year, maps illustrating the mineral structure of the Isle of Wight and other parts of Hampshire, and also of Wiltshire, Dorsetshire, Gloucestershire, Oxfordshire, and Warwickshire, have been published. These maps embrace an area of 2,357 square miles, while other sheets, amounting to an area of 996 square miles are about to be issued.

The area surveyed during the past year for the construction of new maps, amounts to 1,149 square miles, and comprises, in addition to portions of the counties above-mentioned, large districts of Kent, Sussex, and Surrey. Horizontal sections, chiefly illustrating the coalfields and surrounding formations in the central counties of England, have been levelled over 300 miles.

In Scotland, only two surveyors have hitherto been permanently employed, and considering the smallness of the number, the amount surveyed is satisfactory. The work was begun near the metropolis, and the counties of Edinburgh and Haddington are far advanced towards completion (*See* Map B).

The surveys are made on the six-inch map, but the results cannot be communicated to the public until the one-inch ordnance map of each district is issued.

Although the one-inch maps are those which receive the geological outlines and colouring, the survey on the six-inch scale is important in enabling the work to be performed with great care and minuteness. A considerable portion of England and Wales has, however, been surveyed on the one-inch scale only, and the Director-General calls attention to the fact that some of the earlier published maps have proved so defective, that the mining geologist has been unable to lay down with accuracy upon them the rich lodes of iron ore in the important districts of North Devon and Somerset.

Geological Survey of Ireland.

5. In Ireland, during the past year, 1,604 square miles of country have been surveyed, on the six-inch maps, in the counties of Kerry, Cork, Limerick, Kilkenny, and Queen's and King's Counties, and sections have been run along 417 miles of rugged coast. The Director-General calls attention to the accuracy with which the survey is conducted by the use of the large scale employed in Ireland. The skeleton map attached to his report shows the whole state of the geological one-inch map up to the present date, and will prevent the necessity of printing the special returns which have been called for during the two last sessions of Parliament on this subject. An unavoidable delay, resulting from a mechanical difficulty in the printing of the maps, has prevented their rapid publication; but this has been now overcome, and four of the quarto sheets have been issued to the public.

Palæontological and Mining Branches of the Survey.

6. In regard to the palæontological branch, upon which the accuracy of the survey so much depends, the Director-General reports himself satisfied with the work performed, but points out its inadequacy to

Report of Secretary.

keep up with the accumulating materials of the three kingdoms. In Ireland, especially, the stores collected have been very imperfectly examined; and as the survey progresses in Scotland this inconvenience will become still more manifest. Your Lordships have had the subject under consideration, and will take measures to remove the inconvenience, if Parliament approve of the estimate which has been prepared for the present year. Altogether above 15,000 British and 545 foreign specimens have been classified, 742 of them having been placed in the cases of the Museum.

The rich store of duplicate specimens in possession of the Museum might be made extensively useful by giving to the provinces and to our colonies, well authenticated series of the fossils of different strata, thus enabling them to identify the exact geological position and age of the local rocks under examination. The importance of this has not been lost sight of by Sir Roderick Murchison, the Director-General of the survey, who has caused twenty-two sets of duplicates to be prepared for distribution, amounting to about 7,000 specimens.

7. The coast survey has been proceeded with by Mr. Huxley, but the results have not yet been published, from the necessity of completing the catalogue of the natural history portion of the Museum. Memoirs on the fisheries of the Bristol Channel and on the recent changes of its level are, however, to a great extent, ready.

8. The mining geologist has published notes on the iron-producing districts of the northern counties of England, and has examined and mapped the geology of the coalfields of Nottingham. Mr. Smyth, whose special knowledge of mining and mineral industry has been of great service to the Institution in Jermyn Street, having received a public appointment in connexion with the Crown Mines, has, in consequence, resigned his appointment as mining geologist to the survey. It is, however, fortunate for the public service that his new duties are not

found to be incompatible with his position as lecturer on mining in the Government School of Mines. It would have been difficult to have replaced this officer, who has shown much zeal and ability in imparting instruction in mining and mineralogy to the pupils of the school. Report of Secretary.

9. In the last report it was stated that in future the geological sheets would be illustrated by printed descriptions, and a commencement has been made by the publication of a memoir on the country around Cheltenham. Other descriptions are in preparation. Several printed works in connexion with the survey have been published. Among these are the Decades of British Organic Remains (V. and VIII.) The latter has been gratuitously furnished by Sir Philip Egerton, whose qualifications for the work which he has undertaken are well known to men of science. The former decade has been prepared by the palæontologist of the survey, with the aid of Dr. Wright, of Cheltenham, and Mr. Woodward, of the British Museum. A full memoir on certain formations in the Isle of Wight, by the late Professor Edward Forbes, has been produced under the able superintendence of Mr. R. Godwin-Austen, with the aid of Mr. Bristow and Mr. Salter, of the Geological Survey, Mr. Morris, and Mr. Rupert Jones.

10. There are several gratifying circumstances in connexion with the geological survey, to which I have now to draw attention (*vide* App. p. 43). The public are now taking more advantage than formerly of the results of the survey; this being evidenced by the fact that the sale of maps and sections during the past nine months has been nearly double that of any entire preceding year. 2,422 maps and sections have been sold from the 1st of April to the 31st of December. Geological surveyors, trained in the Geological Survey of the United Kingdom, are now actively engaged in prosecuting similar surveys of the mineral resources of the British colonies. In Canada, under Sir William Logan, who formerly rendered valuable aid to the Survey of Great Britain,

Report of Secretary.

a well-organized survey is in operation; and in India, Professor Oldham, formerly Local Director for Ireland, is actively engaged in a similar undertaking, his staff having been augmented during the past year by officers trained in the survey of the United Kingdom. The survey of the West Indian colonies has been begun under Mr. Wall, a pupil of the Government School of Mines, and other colonial surveys are said to be in organization. Lord Canning, the Governor-General of India, has connected with the Geological Survey of India a Museum of Practical Geology, (on the plan of that in Jermyn Street,) which had been instituted some years since under independent management.

11. In concluding the report on the progress of the geological survey for the past year, the Director-General calls attention to the necessity for increasing its staff. Its rate of progress is now known, and with its present strength, it cannot hope to be able to keep up with the published Ordnance maps of many of the most important mining and mineral districts. The inhabitants of those tracts naturally feel the importance of a correct mineral survey, in order to learn correctly their industrial resources, and your Lordships having felt that their wishes should be gratified, have directed that a small addition should be made in the estimates for an increase in the number of geological surveyors.

B. *Mining Record Office.*

12. This office continues, under the new arrangements described in the previous reports, to obtain much useful information. The keeper has visited various parts of Staffordshire, Derbyshire, Durham, Lancashire, Cumberland, Northumberland, and also some of the most important mineral districts of Scotland, with a view of obtaining proper returns of the mineral produce of the kingdom. A volume on the Mineral Statistics of the United Kingdom for 1855 was published last July. The usefulness of amassing information of this kind was shown by the office

being immediately able to supply a return ordered by the House of Commons of "the quantity of coal, iron ore, copper ore, lead ore, tin ore, silver, zinc ore, salt and other minerals raised in each of the mining counties for the years 1854, 1856, respectively." During the past year 146 plans and sections of mines have been deposited in the Mining Record Office, besides the statistical documents already alluded to. Report of Secretary.

C. *Government School of Mines.*

13. The systematic courses of Lectures in this school during the year were as follows:—

90 lectures on Chemistry by Dr. Hofmann.
48 „ Physics by Prof. Stokes.
50 „ Metallurgy by Dr. Percy.
60 „ Mining } by Mr. Smyth.
40 „ Mineralogy }
30 „ Geology by Prof. Ramsay.
50 „ Natural History by Prof. Huxley.
36 „ Applied Mechanics by Prof. Willis.

These courses are attended by the regular or matriculated students of the school who alone being subject to examinations can compete for the prizes; they are also open to general students on payment of a fee. Inserting the entries for the term begun since the Director's report was made, the returns are as follows:—

	1855–56.	1856–57.
Matriculated students	14	7
General students	56	44
	70	51

Adding eight matriculated students of the previous year, there are at present fifty-nine students of both kinds in attendance on the lectures.

The extended evening courses of lectures for the general public and for schoolmasters, noticed in the last year's report as likely to be renewed, have not been given.

The lectures to the working men, consisting of short courses of six lectures on each subject continue

Report of Secretary.

to be attended by as many persons as the theatre will hold, viz., 600. The tickets are eagerly sought for by artizans, and the greatest attention is paid to the instruction afforded. The subjects of the present year are natural history, geology, and applied mechanics. The courses are not yet completed, but there is no doubt that in all 1,800 persons will take tickets; these are issued at 6*d.* for each course, or at the rate of one penny for each lecture. The number is less than the return of last year (2,400), because three courses only, instead of four have been given.

14. The laboratories of the institution are fully taken advantage of by the public, as is indicated by the following returns:—

	1855.	1856.
Royal College of Chemistry, under Dr. Hofmann - - - -	104	108
Metallurgical Laboratory, under Dr. Percy - - - -	24	24

Publications of original researches in the laboratory by Dr. Hofmann continue to be made, and inquiries for various public departments have been instituted. Dr. Percy has communicated to the public part of the results of a detailed and careful examination of British iron ores, a work of great labour and value to the iron-producing districts of the kingdom.

D. *Museum of Practical Geology.*

15. The number of persons who have visited this Museum has considerably increased, partly owing to the fact that it is now opened to the public during five days of the week instead of three days as formerly. The visitors in 1856 amounted to 20,415, being an increase of 7,360 over the return for the previous year. A popular guide to the Museum will be published in the course of the present year. More extensive descriptive catalogues of the various collections are in preparation under the supervision of the respective professors.

2. Training School of Art, Female Art School, Museum and Library of Ornamental Art.

Report of Secretary.

A. *Training and Metropolitan District Schools of Art.*

16. The report of Mr. Burchett, the Head Master of the Training School (App. p. 59.), will be found to give full details, in regard not only to the instruction of the masters in training, who are qualifying themselves to become teachers in local schools, but also as to the cost of each student to the public.

The masters in training, besides studying Art in the Central School, are exercised also in teaching it in district and parochial schools throughout the Metropolis.

The total number of teachers in training during the past school-year has been 106, of whom eighty-nine were male and seventeen female students. Thirty-seven masters have received certificates from the Department during the year, twenty-two of these being for the first or lower group of subjects, and the remainder for higher groups. A large proportion of the students naturally come from the Metropolis, as they are more able than provincial students to take advantage of the instruction offered by the Department; but it is always open to the students of provincial schools when their qualifications have been found to come up to the standard of admission. During the last year eleven metropolitan students took the first certificate at an average cost to the public of 27*l.* 3*s.* 8*d.*; while the average cost of eight first certificates taken by provincial students was 35*l.* 8*s.* 9*d.* Twenty-one students have been appointed to masterships in the course of the year, and are now engaged in teaching in the provinces.

The number of students attending the training school during the past year has been 405, which is a small increase on the number for the previous year. The fees have experienced a considerable augmentation, having been 728*l.* as compared with 517*l.*

17. The number of district schools in the Metropolis continues as before, one new one having been opened at Hampstead, while the school at Camden

Report of Secretary.

Town has been discontinued. The Westminster school has been temporarily suspended from local causes, but is likely soon to be re-opened. The monthly average of pupils who have attended all the district schools has been 476, being a small increase of ten above the average of the previous year.

18. The most gratifying point in connexion with the training school during the past year is the large increase in the number of children in the parochial schools, which are taken into connexion with the former in order to practise the masters in teaching. Forty-one schools of this class are now taught, this number being an increase of eight schools during the year; the number of children receiving instruction has increased from 1,730 to 3,346. It is important to remark that the ordinary teachers of these schools are becoming able to impart instruction in drawing. Of the above number, twelve schools, with twenty-eight teachers, are now giving Art instruction to 1,000 children. In the central school 194 schoolmasters were taught drawing, and in the district schools 251. The sum paid to the Department for parochial instruction in the Metropolis was 295*l.* This sum, added to 25*l.* received from the Whitelands Female Training School, and to 32*l.* 10*s.* received for the instruction of schoolmasters, makes, with the receipts of the Central school (728*l.*), a total amount of above 1,080*l.* paid for instruction given by the training school during the past year.

B.—*Female School of Art, Gower Street.*

19. This school has experienced a small diminution both in the number of pupils, and in the fees received during the last year. The number of students at the morning classes has been 104 (in the previous year, 122), and in the evening classes, 22; the latter number being the same as in the former year. The fees have fallen from 259*l.* to 240*l.* From the changes made in the exhibitions of the Department, the works of the pupils have not yet been brought into competition, but they have been more numerous than in the preceding year.

C.—*Museum of Ornamental Art.*

20. The acquisitions to this Museum will be found fully described in the report of the Curator (App. p. 73). The purchases made have, to a considerable extent, been regulated by the desire to render more complete specific sections of the Museum; and, in consequence of this arrangement, the works in metal have been chiefly increased.

21. The most marked event connected with the Museum has been the display of the remarkable collection purchased from M. Soulages, of Toulouse. The circumstances under which this collection, consisting of 750 specimens, was deposited in the Museum, are somewhat peculiar. A number of gentlemen, interested in the promotion of Art, learning that this well-known collection was for sale, subscribed a guarantee to the extent of nearly 25,000*l.* and purchased the whole collection. As their object was purely disinterested, a clause in the deed of guarantee having rendered profit impossible to them under any circumstances, they offered to deposit the whole collection in the Museum at Marlborough House, with the view of allowing the public to judge whether it should be bought for the nation. This proposal being strictly in accordance with the rules of the Museum, permission was accorded. An uncommon interest has been manifested by the public in the collection; for in the two months during which it has been open to the general public, as many as 48,093 persons have visited it, of whom 5,126 persons paid for admission; the latter number being much greater than that which any previous exhibition has drawn in a similar period.

The gentlemen who bought the collection at their own risk offered to sell it to the nation for the exact sum which it cost to procure and display it; and your Lordships recommended the proposal to the favourable consideration of the Treasury. Public considerations, however, induced the Government to decline this offer. The managers of the Art Treasures Exhibition in Manchester have ultimately purchased

Report of Secretary.

the collection from the original subscribers, who, in the deed of sale, have stipulated for certain conditions in favour of the public, if it be put up to auction at the close of that Exhibition.

22. The public has had the advantage of seeing in the Museum upwards of 100 articles of high artistic and pecuniary value, which Mr. Field deposited in it for a considerable time. These additions have much increased the attractions of the Museum, and added considerably to the number of visitors, although the number of days on which the Museum has been opened was less than in the preceding year.

1856, open 210 days, number of visitors,	111,768
1855, open 231 days, „ „	78,427
Increase of visitors in 1856 -	33,341

Circulating Museum.

23. This collection, which consists of a selection of objects from the Central Museum, continues to be sent to the provincial towns having Schools of Art. It meets with a varied success, according as the arrangements made by the locality for its reception are good or bad; and it is influenced, also, by the character of the town in its relation to industrial pursuits. Thus the Circulating Museum was exhibited at Hanley in the Potteries, during the last year, where it was visited by 20,572 persons, of whom 18,793 paid for admission. In Newcastle-on-Tyne, a much larger town, but where the industry does not bear the same relation to Art, it was only visited by 1,310 people, of whom 561 paid for admission. Allowing for these variations, which will always occur, the results of the experiment have been eminently successful in improving public taste in the locality to which the Museum has been sent. The total number of visitors during last year to the Circulating Museum was 32,852, of whom 27,436 were admitted by payment (App. p. 79). Visitors, under certain rules, are allowed to make drawings of the

objects exhibited; and in 234 cases this privilege was taken advantage of. In 1856 the towns in which the Circulating Museum was exhibited were Sheffield, York, Newcastle-on-Tyne, Caernarvon, and Hanley in the Potteries. In the previous year the towns receiving it, with one exception, were, besides being populous, engaged in artistic manufactures (Birmingham, Nottingham, Macclesfield, Norwich, and Leeds), and the result, as might be expected, was shown by a larger number of visitors, amounting in that year to 55,701. Report of Secretary.

It is gratifying to state that the efficiency of the arrangements for the transport of the articles has been such, that, notwithstanding the fragile nature of many of them, not a single accident of any kind has yet occurred.

Central and Circulating Library.

24. The Library of Art attached to the Department has been closed during three months for removal, besides the usual two months of vacation. The number of visitors was 5,346 for the seven months, while that of 1855, was 7,242, showing an average increase on the daily attendance, the numbers being for the two years thirty-two and thirty respectively. The increase in the subscribers mentioned in last year's report also continues, if deductions be made for the three months of removal. In the corresponding period of the two years, January to July, both inclusive, the subscribers were 207 in 1856, and 169 in 1855. (*See* App. p. 83.)

25. Arrangements have been made to circulate important Works of Art from the central library through the provincial schools (App. p. 26.) The committees of the schools have shown great interest in this proposal, and have offered various useful suggestions for the efficient working of the system.

3. Museum of Irish Industry.

26. The collections of this Museum have had considerable accessions during the past year. These have,

Report of Secretary.

in a great measure, been obtained from the manufacturing districts, through the visits of Dr. Sullivan, formerly chemist to the institution, and now lecturer on chemistry to the school in connexion with it. It has been found that personal explanations of the objects of the Museum to the manufacturers of articles illustrated in its collections have always resulted in hearty co-operation on their part. Sir Robert Kane, the Director of the Museum (App. p. 85), furnishes the names of those who have so materially aided in completing its collections.

The Museum has been visited during the day by 15,329 persons, and in the evenings, when lectures are being delivered, by 16,282 persons, the total number being 31,611; this shows an increase of 6,603 above the returns for the previous year.

27. The courses of lectures in the School of Applied Science connected with the institution have been considerably improved. By the consent of the Royal Dublin Society, the courses of popular lectures given at that institution were made introductory to the more extended courses followed in the Museum of Irish Industry. The number of tickets sold, amounting to 780, and the increased attendance on the public lectures, are satisfactory. The public lectures were attended by an average total of 767 persons. When each visit of the same person to a course of lectures is represented as a separate individual, (this being the usual mode in which the returns have been made from Dublin, though one calculated to produce mistaken impressions), the comparison of the two last years is as follows:—

	1855.		1856.	
	Systematic.	Free.	Systematic.	Free.
Geological Lectures -	1,475	2,414	5,329	—
Natural History - -	302	- -	738	822
Chemical - - -	1,190	- -	5,121	1,557
Physical - - -	436	4,365	1,805	—
	3,403	6,779	12,993	2,379

The number of persons who submit to the examinations upon the subjects of the lectures has also increased. Each lecturer has examinations upon his own course, and at the end of the session a general examination is held on the collective subjects of all the courses. These examinations have excited a lively interest among the students. His Excellency the Lord Lieutenant, recognising their importance, attended the institution, and himself conferred the honours on the successful candidates.

4. Royal Dublin Society.

28. The varied objects of this society are prosecuted with increased vigour, and a marked improvement has occurred in the returns of the present year in most of its departments. (App. p. 105.)

The Botanic Gardens continue to be extensively visited, the numbers in the last year having been 32,900. The curator draws attention to the fact that only a small income (about 30*l.*) is derived from the admission fees on the two pay-days in the week, while sometimes 200 or 300 persons have applied to enter on those days and have withdrawn in consequence of the charge. Their exclusion probably arises from the fee for admission (6*d.*) being too high for the class of persons disposed to take advantage of these gardens. Your Lordships would, no doubt, be glad to see still further facilities afforded to the public, should the society deem it advisable to open the Botanic Gardens on the same terms as the Zoological Gardens in Dublin, in which the charge of admission on certain days in each week is only 1*d.*

The conservatories in the gardens have partly been rebuilt by a Parliamentary vote, but other portions are in a dilapidated condition, and should be restored. It is with regret that this Board was unable to include a sum for this purpose in the estimates of the present year. The report of the Curator of the Botanic Gardens still indicates a tendency on the part of the Society to persevere with the formation of a Museum of Economic Botany. The whole objects

Report of Secretary.

comprised within such a museum should be included in the Museum of Irish Industry, and it is one great object of the union of the different scientific institutions in Dublin to prevent public money being wasted by the creation of duplicate collections. The illustration of the science of Natural History was reserved to the Royal Dublin Society, and of its applications to the Museum of Irish Industry. Although no money appears to have been spent in purchasing objects for the Museum of Economic Botany, still the expenses attending the display of donations amount in principle to the same thing, and perpetuate evils which at this early stage could readily be altogether avoided by a strict attention to the defined limits of the two Museums. The Royal Dublin Society has hitherto met the wishes of the Government on these subjects with such a liberal spirit, that it will no doubt ere long be prepared to resist the desire of any of its officers to extend the collections or museums of the society beyond their proper limits. The public interests on this point are so obvious, that they cannot for the present be committed to any more efficient keeping than the whole society as a body, which is well able to control the zeal of the promoters of special objects, when these are incompatible with the general interests of the institution and the public. The Museum of Irish Industry has also specimens which belong more properly to the Museums of the Royal Dublin Society, and your Lordships are prepared to cause exchanges to be effected.

29. The Museum of Natural History will soon be transferred to the new building erected for it, partly by subscription and partly by public grant, and, with increased space, will receive the full benefit of the arrangement and classification which its zealous curator has already bestowed upon it.

30. The Library of the Society shows as yet little increase in the numbers of its readers, but when the new Museum has been occupied, increased accommodation will be procured for the Library, and arrangements may then be made to enable the working classes to take advantage of it in the evenings.

31. The agricultural exhibitions of the society are conducted with vigour, and it will be seen by the returns in the Appendix (page 114), that in some important departments the exhibitions are more taken advantage of than those of the Royal Agricultural Society of England or the Highland Agricultural Society of Scotland. The following returns indicate the proceedings of the Society during the last year as compared with 1855:— Report of Secretary.

	1855.		1856.	
Botanic Gardens	30,850		32,900	
Museum of Natural History	12,786		31,811	
Agricultural Museum	24,763		25,370	
Library	9,476	Daily average, 32	9,494	Daily average 32
Statue Gallery	4,038		7,400	
School of Art	421		392	
Exhibition of Prize Drawings and Photographs	714		1,578	
Evening Meetings	800		737	
Agricultural Exhibitions	12,801		13,113	
Lectures on Chemistry	148		108	
„ Geology and Mineralogy	216		591	
Lectures on Physics	386		131	
„ Natural History	190		154	

4. Royal Zoological Society of Ireland.

32. The Zoological Society, which receives an annual grant of 500*l.*, attracts a large number of the working classes to its gardens, as many as 108,767 persons having paid the lowest admission fee of 1*d.* On the whole year, the number of visitors amounted to 124,976, which is a less number than in the previous year (138,019). The gardens and collections have been considerably improved. It is with deep regret that I have to announce to your Lordships the death of Dr. Ball, the secretary of this society. To his unremitting exertions and enlightened views, the success of the gardens has been in a great measure owing. (App. p. 135.)

Report of Secretary.

5. Committee of Lectures.

33. The Committee of Lectures continues to arrange for the lectures common to the Royal Dublin Society and to the Museum of Irish Industry, and also to organize and superintend the courses of popular lectures given in the provinces. In regard to the first of its duties the Committee has arranged that the common courses of lectures given in Dublin should be of an elementary character, introductory to the systematic courses given in the Museum of Irish Industry, instead of being merely disjointed courses of a few popular lectures, as on previous occasions.

34. The Committee has during the past year made an important experiment in regard to the provincial lectures. It has been for many years the practice to send lecturers to the provincial towns of Ireland, with the view of giving short popular courses of lectures on Science. These courses excited more or less public interest, according to the nature of the subject and the ability of the lecturer, but no direct proofs of their utility existed. With the view of obtaining some positive indications as to the results of such popular teaching, this Board authorized the expenditure of a small sum (200*l.*) for the purpose of instituting examinations and awarding prizes on the termination of each course of lectures (App. p. 142). Examination papers on the subject of the lectures were prepared by the lecturers (App. p. 143), and the answers to these papers were sent for adjudication to independent examiners, generally professors, either in Trinity College Dublin, or the Queen's Colleges. Although the experiment was a new one, and little previous intimation could be made of the intention to hold examinations, the results have proved much more favourable than could have been anticipated. The interest excited in the locality by the examinations has been considerable, and private liberality has been evoked in their support, voluntary subscriptions having been placed at the disposal of

the local committees to augment the value of the Government premiums. The character of the answers received has naturally been unequal in the different towns, but, as a whole, the examiners have expressed high admiration of the information acquired under this stimulus to attention. Having examined the successful papers, I gladly bear testimony to their excellence, and trust that the Board will consent to the experiment being repeated for the present year under the more favourable circumstances which will result from the experience already gained. The average number of persons who have attended the provincial lectures in 13 towns has been 2,165; the number in 1855 was 1,719. Report of Secretary.

6. Normal Lace School.

35. This school was established chiefly for the purpose of instructing teachers for provincial lace schools, in the hope that a remunerative branch of labour suited to females might be established in Ireland. The Parliamentary vote of 500*l.* per annum was given in aid of the school, and in consequence of this aid, with the active co-operation of the committee of ladies superintending it (App. p. 157), the general education in the school and the special instruction in lace-making became much improved. The lace made at the school is excellent in quality, and the designs for it have been rendered better by giving instruction to the pupils in drawing. Notwithstanding the marked improvement in the special instruction of the school, there is no longer a demand for it. The pupils who now enter do so for the purpose of acquiring the advantages of the general education which it affords, but, as the Committee remark, "the lace-making is not sought either by the pupils themselves or by their parents for them." Under these circumstances, this Board has with great regret intimated to the Committee that it will not ask for a renewal of the Parliamentary vote (beyond a sum to meet existing liabilities), the objects for which it was granted by Parliament being no longer followed out by the

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pupils of the school. As the Committee have raised the character of the school, both as regards its general education and special instruction in lace-making, its failure can only be attributed to the fact that there is not a sufficient demand for the labour to make its exercise profitable.

7. Scottish Industrial and Natural History Museum.

36. The interest manifested in the National Museum in Scotland has produced large accessions to its collections during the past year, as will be seen by the report of the Director (App. p. 161). The time has now arrived when it becomes necessary to fulfil the intentions of Parliament, by providing a building to receive the rapidly accumulating collections of the Industrial section and the rich stores already belonging to the section of Natural History.

It was mentioned in my last report, that a certain site had been purchased for the new Museum buildings behind the University of Edinburgh. Although the site was in itself considerable, yet the demands for accommodation in the buildings to be constructed upon it were greater than they could be expected to afford under the mode of construction proposed. With the view of using the site to the best advantage, Captain Fowke, R.E., was requested to inspect it, and to report on the subject. After a careful examination he has proposed a form of building, which may be completed at a cost of about 40,000*l*., and will supply the requirements of the two Museums. It has accordingly been determined to apply to Parliament for a vote to commence the building.

37. The collections of the Industrial section of the Museum are only in course of organization, and cannot be exhibited to the public. The laboratory attached to this division has had 24 pupils in attendance, and the technological lectures 52 pupils, in both cases the increase during last year being considerable.

38. The Museum of Natural History continues under the new arrangements to be much visited. In the year 1855 it came for the first time under the Department, and the following returns will show the effect of reducing the entrance fee from one shilling to sixpence, and of making one day in the week free of charge. Report of Secretary.

	Number of Visitors.
1854 - - - -	833
1855 - - - -	100,947
1856 - - - -	90,770

The novelty of the working of a new system naturally caused a large number of visitors, but it is gratifying to observe, that when this novelty has passed away, the interest in the Museum continues to show only a small abatement.

Ready access to the Museum, free of charge, is given to the students of Natural History attending the University, and the different denominational colleges of Edinburgh.

The collections continue to improve, and to be classified, but the limited space renders efficient arrangement and classification difficult. (App. p. 171).

II.—AID to SCHOOLS under the INSPECTION of the DEPARTMENT, having reference to SECONDARY EDUCATION.

1. Local Schools of Art.

39. The mode in which the Department promotes instruction in Art throughout the country has been repeatedly explained in previous reports, and it may now be sufficient to describe the general results of the action.

The advanced instruction in art given in the schools has been made more efficient during the past year by the introduction of a constant system of inspection. In former years, the actual inspection of Art Schools was occasional only, but certain works were required to be sent up to London for inspection and exhibition, and rewards were then given according to

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their excellence. By this system, the whole works of the school did not come under inspection; and when the works involved a knowledge of the science of form, such as geometry, perspective, and orthographic projection, there was no evidence that the student understood the principles upon which he worked, as good execution only was considered, and the work might be a mere copy. The Metropolitan Exhibition was in consequence discontinued, and Inspectors were sent to each town where there was a School of Art to examine all the works of the school and to reward excellence by *local* medals. The works thus rewarded are to be collected and exhibited in one common annual exhibition, which during the present year will be held in Manchester, and a limited number of the most deserving of all the works which have obtained local medals will be rewarded with *national* medals. Very favourable effects are found to arise from this change in the system of exhibition and prizes.

The Schools of Art continue to operate upon primary schools, which are taught drawing through their agency. This part of their duty will be fully explained in a further section of the Report.

40. The number of Local Schools of Art in the provinces amounts to fifty-six, being an increase of three during the past year; adding the nine district Metropolitan schools, the training and female schools, the total number of Art Schools now under the Department is sixty-nine. The following returns will show the number of students of all classes who have attended them in 1856, as compared with the corresponding period in the previous year:—

	1855.	1856.
Provincial schools - -	8,274	10,204
Metropolitan district schools -	466	476
Central female schools - -	144	126
Masters in training - - -	79	106
Schoolmasters, pupil-teachers, &c.	1,547	1,425
	10,510	12,337

Making a general return of their numbers, it would be as follows :— Report of Secretary.

	1855.	1856.
Pupils at Schools of Art	10,510	12,337
Pupils at Public Schools	18,988	22,746
	29,498	35,083

Full returns in regard to the financial conditions of the schools and to their general working will be found in Tables in the Appendix, pp. 206 to 220.

2. Local Schools of Science.

41. During the last year the attendance at the Schools of Science, including under that designation Navigation and Trade schools, as well as separate scientific institutions, have considerably increased. In the year ending December 1855, 9,128 persons attended the schools and public lectures given in connexion with them. In the year ending December 1856, the number of persons who attended these schools amounted to 11,661 (*Vide* Appendix, p. 204). New schools were opened in 1856 at Aberdeen, Bristol, Leeds, London, Newcastle, and Waterford. The scientific schools are of two kinds, viz., secondary schools, in which only science is taught; and intermediate schools, in which advanced elementary instruction is given to prepare the pupils for scientific instruction.

Periodical examinations for prizes are now held at each of the separate scientific and intermediate schools, and it is the intention of your Lordships to take into consideration, how far the benefit of such examinations may be extended to the general public whether they attend the schools or not. The application of a system of examinations to the courses of public lectures has already been alluded to in Section 34.

42. The intermediate trade and navigation schools continue to increase steadily in the number of pupils. It was explained in the last report that separate scientific institutions were too far apart from the elementary

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school to prove a permanent success, without some intermediate instruction to prepare those who have been educated in such schools to take advantage of special scientific instruction. Accordingly in the trade and navigation schools, elementary or junior divisions both for youths and adults have been established with the view of communicating the knowledge necessary to act as the basis for scientific instruction. This has produced a favourable result, and as will be observed by the returns (App. p. 204), a largely increased attendance. At the same time it has added to the expenses of the school. This has been met to some extent by sending the teachers in training to the provincial schools to take charge of the junior classes, until the increase in the numbers of the pupils would justify the committees of management in appointing assistant masters. It would no doubt be very easy, both with regard to navigation and trade schools, to render them at once self-supporting by devoting the attention of the masters to the adults who are willing to attend them and pay considerable fees. In regard to navigation schools, this is especially the case. But sailors who come into port only for a few weeks at a time cannot be thoroughly grounded in the science of their occupations, and the knowledge communicated to them must be necessarily of an empirical and superficial character. On the other hand, boys who are destined for a seafaring life may be kept one or two years at such schools, and may be well grounded in the principles of navigation. Instruction of this kind for sons of sailors is, however, new to the maritime population, and it will take some time before the necessity for it is fully recognized. In a national point of view your Lordships have recognized the importance of securing an attendance of boys to the navigation schools rather than that of adults. I am glad to state that there is a steady increase in the numbers of boys in all the schools, and in consequence of the larger number of teachers there has also been an augmentation in the numbers of adults. Although for two or three years

the schools for boys may not be self-supporting, if they increase as steadily as they do at present we may look to the time when even this section of the schools will be found to derive a sufficient sum from fees of pupils to meet the expenses attendant upon them. Mr. Hughes, the Inspector of Navigation Schools, has examined all of them, and especially distinguishes the school at Hull for the efficiency of its instruction. The class of papers given in the examinations will be best understood by the examples printed in the Appendix, p. 175. Report of Secretary.

III.—AID TO SCHOOLS NOT CONNECTED WITH THE DEPARTMENT.—PRIMARY INSTRUCTION.

43. The diffusion of primary instruction in Art engages the anxious attention of the Department. Each Art school attaches to itself a certain number of public or private schools, which receive one or more lessons weekly in elementary drawing. Facilities are also given to the teachers and pupil-teachers of public schools to qualify themselves to impart instruction in drawing to the pupils under their care. In the provincial schools, 1,231 teachers and pupil-teachers have availed themselves of these facilities during the past year, the return for the previous year, in the same schools, being 1,097. It is gratifying to find that the teachers of public schools are now, in many instances, able to communicate the necessary elementary instruction by themselves, and thus benefit more largely by the aid of the teachers of the Art schools. Including the public schools in connexion with the Training School in London, 22,746 children were taught drawing last year, while in the previous year the number taught was 18,988.

44. Your Lordships considered it to be desirable to give a further impulse to the diffusion of primary instruction, and accordingly small rewards of instruments and materials for drawing have been offered as rewards to all scholars who are successful in complet-

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ing the papers included in the examination of the first grade. It was not made a condition in these examinations, that the candidates should have attended schools in connexion with this Department. The public object to be attained is that a certain amount of power in drawing should be possessed by all, and it is a matter of indifference where the instruction has been received. As the State desires to have a certain result, it may pay for it, without inquiring into the means by which it has been produced, if it be satisfied that the instruction given is of a sound character. It may be contended, however, that under an open system of competition of this kind, the public money might be expended in promoting art-instruction among classes who were sufficiently well able to obtain it without the aid of the State. But as the whole money value of the prize offered for competition is limited to a few shillings, there is but little inducement offered by it for the higher classes to enter into competition, while in the present imperfect state of instruction in art, it would be impolitic to exclude any persons who desired to learn drawing in the precise and systematic manner required for successful competition, even for these small prizes. The total amount to be expended in prizes of this kind can always be regulated, and as the demand for them increases, the standard of excellence can readily be raised. (See Report of Mr. Redgrave, App. p. 51, and Table, App. p. 216).

45. The introduction of scientific teaching, as a separate branch of study to primary schools, is attended with considerable difficulties, and can only be carried out gradually and with much caution. Already the claims upon the attention of the pupils are so numerous, that without affecting the main objects of the school, it would be difficult to obtain separate periods for scientific lessons. The first point for success is to enable the schoolmasters to illustrate the common lessons by his own scientific knowledge, and with this view, increased attention has been given to instruction in science in Training Schools. The Department has

also in its separate Schools of Science formed classes for schoolmasters and pupil-teachers.

46. The Training Schools throughout the country have hitherto chiefly cultivated the physical rather than the natural sciences, and when the schoolmaster introduces science into his primary school, he generally selects mechanics, physics, or chemistry, as the objects of study. But the sciences of observation, such as zoology, botany, and physiology, are more suitable to the children of primary schools, than the abstract physical sciences referred to, which are better adapted for secondary schools. The study of the sciences of observation would naturally aid and be aided by instruction in drawing, and would implant that love of nature which is required to insure the success of the intermediate schools and separate scientific institutions throughout the country. If these views are correct, it will be for your Lordships to consider whether it would not be desirable to induce an increased study of the sciences of observation in the Training Colleges. Some of the physical sciences, such as chemistry and experimental physics, are required to explain several of the most common phenomena of life, and, in this point of view, may be studied with advantage even in a primary school; while, as their abstractions are relieved by illustrations, they compel observation; but, as a whole, they do not appear to be so well suited to educe a love of nature in the minds of children as a knowledge of the plants, animals, and stones seen in their daily walks.

IV.—AID TO SCHOOLS BY THE FORMATION AND DIFFUSION OF EXAMPLES AND ILLUSTRATIONS, AS A MEANS OF STUDY.

47. With a view to improve the means of instruction, both in primary and secondary schools, an Educational Museum is now in the course of organization, and will soon be opened to the public in charge of Mr. R. Thompson, who had distinguished

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himself in the arrangements of the Exhibition of 1851 and afterwards in the Exhibitions of Dublin and Paris (App. p. 27). Its nucleus has for some time been in the possession of the Government, having been presented to it at the close of the Educational Exhibition in St. Martin's Hall in 1854. This nucleus proved on examination to be insufficient for the purposes of a permanent Museum, and accordingly a classification of the objects required for such a collection has been made, and the co-operation of the producers of educational apparatus has been secured. The want of such a Museum has long been felt, and its establishment has met with hearty support from the educational societies, manufacturers of apparatus, and publishers. The objects exhibited in it will be fully available to those who desire to obtain information in regard to the educational appliances already provided by the usual channels of trade, and means will be taken to furnish, through those channels, more efficient examples, when they are required to meet the demand for them.

48. During the last year, various series of diagrams have been finished; among them are diagrams on botany, by the Rev. Professor Henslow; on geology, by Mr. Jukes, Director of the Geological Survey in Ireland; on extinct animals, by Mr. Waterhouse Hawkins; and on Astronomy by Dr. Drew. Professor Willis has completed his illustrations of mechanical powers, and is zealously engaged in simplifying and preparing for manufacture various examples in applied mechanics. The Rev. A. Rigg, Principal of the Chester Training School has produced some excellent illustrations of mechanical movements, and models fitted for agricultural schools; and to meet the growing demand for educational apparatus, he has erected a manufactory at Chester, of sufficient capabilities to prepare apparatus on a large scale.

The new art examples issued during the last year include elementary examples prepared by the Department, and published by De la Rue, and Pyne's illustrations of water-colour paintings.

49. The number of public schools which have supplied themselves with apparatus and examples through the Department amounts to 290. The average cost of this supply to each school has been 2*l.* 17*s.* 3*d*, and the total cost in aid by the Department was 830*l.* 13*s.* 6*d.* Report of Secretary.

V.—PUBLIC SERVICES CONNECTED WITH THE DEPARTMENT.

50. During the last year, Mr. Sheepshanks has founded a Gallery of British Art in connexion with the Schools of Art attached to this Department, by giving to the nation his splendid collection of pictures and drawings. The deed of gift is printed in the Appendix, p. 3, and is of the most liberal character. A gallery is now in course of erection to contain the collection, which includes 211 paintings in oil, and 100 drawings and sketches. Since this deed of gift was executed, Mr. Sheepshanks has added to the collection by various other donations. When it is recollected that this magnificent collection has been granted to the nation during the lifetime of the donor, and that the conditions of the gift are of the most open description, the public will no doubt appreciate the disinterested spirit in which it has been made.

51. The large iron museum at South Kensington has now been given over to the Department by the Commissioners of the Exhibition of 1851, under whom it was erected. Various public bodies and societies have gladly taken advantage of the space offered by it, and already it is fully occupied. The Commissioners of Patents have organized a Museum of Patented Inventions, and will exhibit it to the public in this building. The Committee of the Architectural Museum are now arranging in it an interesting collection of architectural casts, chiefly of the medieval period. The Institute of British Sculptors has appropriated a portion of the gallery to a display of works of English artists. The Commissioners of the Exhibition of 1851 have undertaken to illustrate

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the useful applications of animal products, in addition to the objects presented to them after the Exhibition. The museums now referred to, and those belonging to the Department, such as the Museum of Ornamental Art and the Educational Museum, will completely fill the large iron building at South Kensington.

SUMMARY.

52. It may be useful to make a general summary of the information given in detail in various parts of the Report.

In nearly all the Museums and Libraries in connexion with the Department throughout the kingdom, a considerable increase in the number of visitors has taken place during the last year. The total number of persons amounted to 366,838, being an increase of 35,362 persons on the return for 1855. This number would no doubt have been still greater if it had not been found necessary to close the Central Art Museum for the last three months of the year, with a view of removing it from Marlborough House to South Kensington.

The botanical gardens in Dublin have been visited by 32,900, and the zoological gardens in that city by 124,976 persons; in the former case, the increase is 2,050 visitors; in the latter case, the decrease is 13,000.

The Exhibition of the Soulages collection was visited by upwards of 48,000 visitors, and the agricultural and other exhibitions of the Royal Dublin Society by 14,691 persons.

The geological surveys in Great Britain and Ireland continue to be carried on as rapidly as the present number of surveyors will permit. In England 1,149 square miles have been surveyed, and sections illustrating the coal fields have been levelled over 300 miles. In Scotland the Counties of Edinburgh and Haddington are nearly completed. In Ireland

1,604 square miles of country have been surveyed, and sections have been run along 417 miles of rugged coast. The Ordnance maps now include many of the most important mining districts of the kingdom, the inhabitants of which naturally desire to have a correct survey of their mineral resources as soon as possible. To accomplish this, a small increase in the number of surveyors is recommended. The Mining Record Office continues to amass and publish important statistical returns regarding the mineral produce of the kingdom. Report of Secretary.

The Schools of Art were attended in 1856 by 12,337 persons, and taught drawing to 22,746 children in elementary schools. In the corresponding returns of the previous year 10,510 students attended the schools, and 18,988 children were taught. A more rigorous system of inspection and examination has been introduced into the schools with beneficial results.

The separate schools of science and public lectures in connexion with them were attended by 11,661 persons; the number for the corresponding period in 1855 being 9,128. Examinations have been instituted in connexion with the public lectures, and have much increased their efficiency. Separate instruction in science is not given in elementary schools through the agency of the provincial scientific schools, but classes for the instruction of schoolmasters have been opened, and apparatus for scientific illustration has been extensively furnished at a reduced cost to the teachers who are able to show that they can use it by passing a prescribed examination.

A Gallery of British Art founded by Mr. Sheepshanks, who has munificently given his valuable collection of paintings and drawings to the nation, is now in course of erection and will shortly be completed. A new museum of educational appliances has been organized, and will be opened to the public next month. Various public bodies and societies have co-operated with the Department to render the iron museum at South Kensington instructive to the

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public. The Commissioners of the Exhibition of 1851 will display a museum of animal products. The Commissioners of Patents have formed a new museum of patented inventions; the Architectural Museum exhibits a valuable collection of casts and models; and the Institute of British Sculptors, illustrations of the works of British sculpture.

LYON PLAYFAIR.

APPENDIX.

APPENDIX.

APPENDIX A.

DEPARTMENT OF SCIENCE AND ART, Marlborough House, Pall Mall, London.

Minute.

At the Council Chamber, Whitehall, the Sixth day of February 1857.

By the Right Honorable the Lords of the Committee of Privy Council *appointed for the consideration of all matters relating to* Trade and Foreign Plantations.

My Lords take into consideration the Deed of Gift by which Mr. Sheepshanks transfers to the President of this Board his valuable Collection of Pictures and Drawings, in order to found a Gallery of British Art, in connexion with the Schools of Art under this Board.

The President has accepted with much gratification the Trusteeship created by this Deed, under the conditions therein described.

My Lords are sensible of the great value of the magnificent gift thus presented to the nation during the lifetime of the Donor, and they desire to express their admiration of the very liberal spirit in which it has been made.

My Lords admit the reasonableness of the condition that the Deed of Gift shall only take effect when a suitable Gallery shall have been provided in an airy situation near the Gardens or Public Parks at Kensington, and they have given directions, with the consent of the Treasury, for the erection of such a Gallery without delay.

Appendix A. MINUTE.

Their Lordships direct that a letter should be written to Mr. Sheepshanks, thanking him, on the part of the Government, for his munificent gift to the nation, and for the open character of the conditions under which it has been made; and stating, that whilst the liberality of these conditions has greatly enhanced its value to the nation, they are well calculated to realize the disinterested object of the Donor to found a Gallery of British Art.

LYON PLAYFAIR.

Approved,
STANLEY OF ALDERLEY,
6th Feb. 1857.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JOHN SHEEPSHANKS of Rutland Gate, Knightsbridge, in the County of Middlesex, Esquire, send greeting.

WHEREAS I desire that a Collection of Pictures and other Works of Art, fully representing British Art, should be formed, worthy of national support, and have the advantage of undivided responsibility in its management, instead of being subject to the control of any body of trustees or managers: And whereas, I conceive that such a collection should be placed in a gallery in an open and airy situation, possessing the quiet necessary to the study and enjoyment of works of Art, and free from the inconveniences and dirt of the main thoroughfares of the metropolis: And whereas I consider that such a gallery might be usefully erected at Kensington, and be attached to the Schools of Art in connexion with the Department of Science and Art now established there: And whereas, with the view to the establishment of such a collection, and in the hope that other proprietors of pictures and other works of Art may be induced to further the same object, I have determined to make such a conditional gift of the original pictures and drawings (the productions of British artists) which I possess, as herein-after expressed. And I do, therefore, hereby transfer the pictures and drawings belonging to me specified in the Schedule hereto, and the property and proprietorship thereof unto, and do declare that the same shall remain vested in the Right Honourable Edward John Stanley, Baron Stanley of Alderley, or other, the member of Her Majesty's Government for the time being charged with the promotion of Art Education now undertaken by the Department of Science and Art as the ex-officio trustee thereof upon the following terms and conditions, viz.:—

1. The said Right Honourable Edward John Lord Stanley, as the first and present ex-officio trustee, shall sign a memorandum of his acceptance of the trusteeship here-under at the foot hereof.

2. A well-lighted and otherwise suitable gallery, to be called "The National Gallery of British Art," shall be at once erected by Her Majesty's Government, and be attached or near to the public buildings built or to be built for the Department of Science and Art on the estate purchased by Her Majesty's Commissioners for the Exhibition of 1851, or the public parks or gardens at Kensington.

Appendix A.

DEED OF GIFT.

3. The said pictures and drawings shall be deposited in such gallery with any other pictures or other works of Art that may be subsequently placed there by other contributors, as it is not my desire that my collection of pictures and drawings shall be kept apart, or bear my name as such.

4. The right of property and possession in the said pictures and drawings shall be solely in the ex-officio trustee for the time being, but subject to the conditions herein expressed; and the said pictures and drawings shall always remain under his sole care and control, and he shall be the sole arbiter of any question that may arise touching the management or disposition thereof under these Presents.

5. The said pictures and drawings shall be used (as the primary object) for reference and instruction in the Schools of Art now or hereafter placed under the superintendence of the said Department, and subject thereto, shall be exhibited to the public at such times as shall not interfere with the arrangements of the said Schools, and under such regulations as the ex-officio trustee shall prescribe; and so soon as arrangements can be properly made by him for that purpose, the public, and especially the working classes, shall have the advantage of seeing the collection on Sunday afternoons, it being, however, understood that the exhibition of the collection on Sundays is not to be considered as one of the conditions of my gift.

6. None of the said pictures and drawings shall ever be sold or exchanged, or be dealt with contrary to the true spirit and meaning of the disposition and control thereof herein prescribed; but this condition shall not restrict the temporary loan of any of them, upon terms sanctioned by the ex-officio trustee, to any place in the United Kingdom where any School of Art exists in connexion with the Department of Science and Art, or generally where there is any safe and proper place for their reception and public exhibition.

7. The ex-officio trustee shall be advised and assisted on matters connected with the preservation of the said pictures and drawings by William Mulready, Esquire, R.A., or failing him, by Richard Redgrave, Esq., R.A., or failing him, by some one other R.A. of London, to be selected by the ex-officio trustee for the time being, as the professional adviser of the ex-officio trustee.

8. That the ex-officio trustee may sell the right to engrave or reproduce any of the said pictures or drawings, upon such terms as he may think proper, but the engravings and reproductions shall be approved by the artist of the picture or drawing engraved or reproduced before publication, and such

artist shall be paid whatever sum may be received by the ex-officio trustee for the sale of such right.

9. The said pictures and drawings, or the conditional gift of them hereby made, shall not be subject to the provisions of the Act of the 19 & 20 Victoria, cap. 29., intituled "An Act to extend the Powers of the Trustees and Directors of the National Gallery, and to authorize the Sale of Works of Art belonging to the Public," or to any future enactment of the Legislature, which, but for this declaration to the contrary, shall have the effect of placing the said pictures and drawings under any other care or ordering than is herein prescribed, or would otherwise alter or interfere with the disposition thereof hereby made. And in case of such interference on the part of the Legislature, or if the terms and conditions as herein expressed be not strictly adhered to, then the conditional gift hereby made of the said pictures and drawings, in favour of a National Gallery of British Art, the Schools of Art, and the public generally, shall wholly cease, and the ex-officio trustee for the time being shall thereupon hold the said pictures and drawings in trust for the University of Cambridge, to be added to, and for ever thereafter form part of the Fitz-William Collection in the said University.

Witness my hand and seal, this Second day of February One thousand eight hundred and fifty-seven.

(Signed) JOHN SHEEPSHANKS. (L.S.)

Signed, sealed, and delivered by the above-named John Sheepshanks, in the presence of

WILLIAM COWPER,
17, Curzon Street, London.

RICHD. REDGRAVE,
18, Hyde Park Gate, South Kensington.

HENRY COLE,
24, Onslow Square.

I, the above-named and undersigned Right Honourable Edward John Stanley, Baron Stanley of Alderley, do accept the trusteeship created by the above deed.

(Signed) STANLEY OF ALDERLEY.

LYON PLAYFAIR, Witness.

Appendix A. DEED OF GIFT. SCHEDULE.

SCHEDULE of the ORIGINAL PICTURES and DRAWINGS, the Subject of the foregoing DEED OF GIFT from JOHN SHEEPSHANKS, Esq.

LIST of PAINTINGS in OIL, the WORKS of BRITISH ARTISTS.

No.	Name of Artist and Subject.
	R. BONNINGTON.
1	A Landscape.
	R. BRANDARD.
2	View of Hastings from the Castle Hill.
3	East Cliff, Hastings.
4	The Priory, Hastings.
	BURNET, JAMES.
5	Landscape—Evening—Milking Cows.
	BURNET, JOHN.
6	Landscape—Cow Drinking.
7	The Fish Market, Hastings.
	CALLCOTT, Sir A. W., R.A.
8	Landscape—Italian Composition.
9	A Brisk Gale, a Dutch East Indiaman landing Passengers.
10	Slender and Ann Page.
11	Dort.
12	Falstaff and Simple.
13	A Seaport and Jetty.
14	An Inn Door.
15	A Sunny Morning.
16	Coast Scene, with Shrimper.
	CARPENTER, Mrs. WM.
17	St. Francis.
18	Sisters—the Artist's Two Daughters.
19	Ockham Church.
	CLINT, G.
20	Portraits of C. Young, as Hamlet, and Miss Glover, as Ophelia.
21	Scene from "Paul Pry"—Liston, Madame Vestris, Miss Glover, &c.
22	La Palermitana.
23	Scene from the Comedy of "The Honeymoon."

No.	Name of Artist and Subject.
	COLLINS, WILLIAM, R.A.
24	Villa d'Este, Tivoli.
25	Cave of Ulysses at Sorrento.
26	Sorrento, Bay of Naples.
27	Rustic Civility.
28	Hall Sands, Devonshire.
29	The Stray Kitten.
30	Bayham Abbey, Sussex.
31	Seaford, Coast of Sussex.
32	A Country Kitchen.
	CONSTABLE, JOHN, R.A.
33	Salisbury Cathedral.
34	Landscape—Dedham Mill.
35	Hampstead Heath.
36	Hampstead Heath.
37	Boat-building, Flatford Mill.
38	River View near Salisbury.
	COOKE, E. W., A.R.A.
39	Lobster Pots.
40	Mending the Bait Nets.
41	Brighton Sands.
42	The Antiquary's Cell.
43	Mont St. Michel, Normandy.
44	A Mackerel.
45	Portsmouth, the Hulks.
46	Hastings, from All Saints' Church.
47	Windmills, Blackheath.
48	Carp.
49	Portsmouth Harbour, "The Victory."
	COOPER, A., R.A.
50	Stable Door, with White Horse.
51	Interior of Stable, with Donkey.
	COPE, C. W., R.A.
52	Palpitation.
53	The Young Mother.
54	The Hawthorn Bush.
55	Maiden Meditation.
56	Charity.
57	Almsgiving.
58	L'Allegro.
59	Il Penseroso.
60	Mother and Child.

List of Paintings in Oil—*continued.*

No.	Name of Artist and Subject.
	Creswick, Thos., R.A.
61	Scene on the Tummel.
62	Summer's Afternoon.
	Croome, J.
63	Landscape near Yarmouth—Moonlight.
64	Landscape.
	Danby, F., A.R.A.
65	Disappointed Love.
66	Calypso Island.
67	Norwegian Scene.
	Davis, R. B.
68	Landscape near Virginia Water.
	Duncan, T., A.R.A.
69	The Wae fu' Heart—"Auld Robin Gray."
	Eastlake, Sir C. L., P.R.A.
70	A Peasant Woman fainting from the Bite of a Serpent.
71	Italian Contadina and Children.
	Etty, William, R.A.
72	Head of a Cardinal.
73	Cupid sheltering Psyche.
	Frith, W. P., R.A.
74	Scene from "The Good-natured Man."
	Geddes, A., A.R.A.
75	A Man Smoking.
76	Study from Giorgione.
	Gauerman, F.
77	Wolves and Deer.
78	Wild Boar and Wolf.
	Holland, James.
79	Landscape near Blackheath.
80	Nimeguen on the Rhine.
	Horsley, J. C., A.R.A.
81	The Contrast—Youth and Age.
82	Waiting an Answer.
83	The Rival Performers.
	Jackson, J., R.A.
84	Portrait of Himself.
85	Portrait of Earl Grey.
	Lance, G.
86	A Fruit Piece.
	Landseer, Sir Edwin, R.A.
87	A Highland Breakfast.
88	The Drovers' Departure.
89	The Dog and Shadow.
90	A Fire-side Party.
91	There's no Place like Home.
92	The Twa Dogs.
93	The Old Shepherd's Chief Mourner.
94	A Jack in Office.
95	Tethered Rams.
96	Sancho Panza and Dapple.
97	The Angler's Guard.
98	A Naughty Child.
99	Suspense.
100	Comical Dogs.
101	Young Roebuck and Rough Hounds.
102	The Eagle's Nest.
	Landseer, Charles, R.A.
103	The Temptation of Andrew Marvel.
104	Sterne's Maria.
105	The Hermit.
	Lee, F. R., R.A.
106	Landscape near Redleaf.
107	Landscape—Gathering Sea-weed.
108	Distant View of Windsor.
	Leslie, Charles, R.A.
109	Scene from "The Taming of the Shrew."
110	The Principal Characters in "The Merry Wives of Windsor."
111	Who can this be?
112	Who can this be from?
113	My Uncle Toby and Widow Wadman.
114	Florizel and Perdita.
115	Aatolycus.
116	Le Bourgeois Gentilhomme.
117	Les Femmes Savantes—Trissotin reading his Sonnet.
118	La Malade Imaginaire.
119	Don Quixote and Dorothea.
120	Laura introducing Gil Blas to Arsenia.
121	Female Head (oval).

Appendix A.

DEED OF GIFT.

SCHEDULE.

LIST of PAINTINGS in OIL—*continued.*

No.	Name of Artist and Subject.
	LESLIE, CHARLES. R.A.—*cont.*
122	Queen Katharine and Patience.
123	Amy Robsart.
124	The Two Young Princes in the Tower.
125	The Toilet—Lady examining a Necklace.
126	Portrait of the Princess Royal—Sketch for the Christening.
127	Portia (an oval).
128	Griselda (an oval).
129	Portrait of Her Majesty in the Coronation Robes (a sketch).
130	Garden Scene—Boy with Cart—Portrait of the Artist's Youngest Son.
131	Dulcinea del Tobosa.
132	Sancho Panza.
	LINNELL, JOHN, Sen.
133	The Wild Flower Gatherers.
134	Landscape—Milking Cows.
	MULREADY, WILLIAM, R.A.
135	Landscape—The Mall, Kensington Gravel Pits.
136	„ Kensington Gravel Pits.
137	„ Blackheath Park.
138	The Seven Ages.
139	The Fight Interrupted.
140	Giving a Bite.
141	First Love.
142	Interior, with Portrait of Mr. Sheepshanks.
143	"Open your Mouth and shut your Eyes."
144	Brother and Sister—Pinching the Ear.
145	Choosing the Wedding Gown.
146	The Sonnet.
147	A Sailing Match.
148	The Butt—Shooting a Cherry.
149	A Toy Merchant.
150	The Intercepted Billet.
151	Landscape with Cottage.
152	Portrait of Mr. Sheepshanks.
153	Landscape—Sketch at Hampstead Heath.
154	Still Life—Bottlege.
155	Landscape—Hampstead Heath
156	Sketch for the Raffle.
157	Small Landscape with Cottage (upright).
158	Cottages, 1806.

No.	Name of Artist and Subject.
	MULREADY, WM., R.A.—*cont.*
159	Sketch for a Picture of Punch.
160	Landscape—Cottage.
161	Hampstead Heath.
162	The Carpenter's Daughter.
	MULREADY, W., Jun.
163	Teal.
164	An Interior—Housekeeper examining Baker's Bill.
	NEWTON, G. S., R.A.
165	Portia and Bassanio.
	NASMYTH, PATRICK.
166	Landscape.
	REDGRAVE, RICHARD, R.A.
167	Cinderella.
168	The Governess.
169	Gulliver exhibited to the Brobdignag Farmer.
170	Preparing to throw off her Weeds.
171	Ophelia.
172	Bolton Abbey.
	RIPPINGILLE, E. V.
173	Beggars of the Roman Campagna.
	ROBERTS, DAVID, R.A.
174	Entrance to the Crypt—Roslyn Chapel.
175	Old Buildings on the Darro, Grenada.
176	Gate of the Mosque of the Metevalis Grand Cairo.
	ROTHWELL, RICHARD.
177	The Little Roamer.
178	Noviciate Mendicants.
179	The very Picture of Idleness.
	SIMSON, WILLIAM.
180	Interior of a Cowshed.
181	Gil Blas introducing himself to Laura.
182	Sketch for a Picture of William Tell.
	SMIRKE, R., R.A.
183	Scene from "The Humorous Lieutenant."
184	Illustration from Beaumont and Fletcher.

List of Paintings in Oil—*continued.*

No.	Name of Artist and Subject.
	Smith, George.
185	Another Bite.
186	Temptation—A Fruit-stall.
187	Children gathering Wild Flowers.
	Stanfield, Clarkson, R.A.
188	Landscape near Cologne.
189	A Market Boat on the Scheldt.
190	Sands near Boulogne.
	Stark, J.
191	Fish Ponds near Hastings.
192	Lloyd's Pulpit Festiniog.
193	Ponds and Windmills, Hastings.
194	Landscape.
195	Distant View of Windsor.
196	Landscape.
	Stothard, Thomas, R.A.
197	Shakespeare's Principal Characters.
198	Tam O'Shanter.
199	John Gilpin.
200	Sir Roger de Coverley and the Gipsies.
201	Twelfth Night.
202	Brunetta and Phyllis.
203	Sancho and the Duchess.
204	Scene from "The Tempest."
205	„ from "King John."
206	Allegorical Sketch.
	Turner, John M.W., R.A.
207	Line Fishing off Hastings.
208	Venice.
209	St. Michael's Mount, Cornwall.
210	Cowes—Royal Yacht Squadron.
211	Vessel in Distress off Yarmouth.
	Uwins, Thomas, R.A.
212	Suspicion.
213	Italian Mother teaching her Child the Tarantella.
214	Neapolitan Boy decorating his Inamorata.
215	The Favorite Shepherd.
	Ward, James, R.A.
216	Donkey and Pigs.
217	Pigs.
218	A Pig.
	Webster, Thomas, R.A.
219	Sickness and Health.
220	Going to the Fair.
221	Returning from the Fair.
222	A Village Choir.
223	Contrary Winds.
224	Reading the Scriptures.
	Wilkie, Sir David, R.A.
225	The Broken Jar.
226	The Refusal, from Burns' Song of "Duncan Gray."
227	Sketch of a Bookcase for "The Letter of Introduction."
228	The Errand Boy—a Sketch.
229	Sketch of a Head and Two Hands.
230	Sketch of the Daughters of Walter Scott.
231	Sketch of a Head for the Rabbit on the Wall.
232	Landscape Sketch—The Gipsy Party.
	Witherington, W. F., R.A.
233	The Hop Garden.

Appendix A.

DEED OF GIFT.

SCHEDULE.

LIST of the DRAWINGS and SKETCHES, the Works of BRITISH ARTISTS, included in the Gift to the Nation by JOHN SHEEPSHANKS, Esq.

No.	Name of Artist and Subject.
	BRANDARD, R.
1	Rocks at Hastings. (Water Colour).
	BROCKEY.
2	Study of a Female Head. (Coloured chalk).
3	Study of a Female Head. (Coloured chalk).
	CALLCOTT, Sir A. W., R.A.
4–10	Seven small Pencil Sketches.
11	River Scene with Sailing Boats. (Chalk).
12	River Scene with Sailing Boats. (Pencil).
13	Rocks and Sea—Isle of Wight. (Chalk).
14	Greenwich Hospital. (Pencil and Indian ink).
15	River, with Bridge and Cathedral. (Chalk).
	COLLINS, WILLIAM, R.A.
16	The Young Boat-builders. (Pencil).
17	Coast Scene. (Water Colours).
18–20	Three Sketches in Water Colours.
21	Naples. (Water Colours).
23	Two Water-colour Sketches.
	COOKE, E. W., A.R.A.
24	Brighton Sands.
25	Lobster Pots.
26	Mending Nets.
	COPE, C. W., R.A.
27	Sleeping Child. (Chalk study).
28	Sketch for the Picture of Palpitation.
29	Sketch for the Cotter's Saturday Night.
30	December and May. (Pen and ink).
31	Child's Head. (Chalk study).
32	The Truants. (Study in pen and ink).
33	Study of Hands. (Coloured chalk).
34	Study of Hands. (Black chalk.)
35	Old Man's Head, praying. (Pen and ink).
36	The Penitent's Return. (Chalk study).

No.	Name of Artist and Subject.
	HOLLAND, JAMES.
37–55	Eighteen Sketches in Water Colours.
56	Nimwegen. (Water Colour)
	LANDSEER, Sir EDWIN, R.A.
57–66	Nine early Drawings in one frame.
67	Stag's Head and Dog. (Chalk).
	LESLIE, CHARLES, R.A.
68	Peril—Don Quixote daring the Lion. (Sketching Society).
69	A Hoax, from "Roderick Random." (Sketching Society).
	MULREADY, W., R.A.
70	Large Chalk Sketch for "Punch."
71	Sketch for the Wrestling Boys. —"Convalescent."
72	Study in Chalk of a Girl.—"Firing the Cannon."
73	Study of Cottages. (Pencil).
74	Study of an old Cottage. (Oil).
75	Study in Chalk for "The Profile on the Wall."
76	Life Study in Chalk.—Eve.
77	Sketch for the Housekeeper in Mr. Sheepshanks' Portrait. (Pen and ink).
78–83	Five Sketches of Head, Hands, &c.—"Barber's Shop."
84	Blackheath Park. (Pen and ink).
85	Hands. (Pen and ink).
86	Study in pen and ink for Male Figure in "Open your Eyes."
87	Large pen and ink Study for Mr. Sheepshanks' Portrait.
88	Another large Study for the same Picture.
	REDGRAVE, RICHARD, R.A.
89	Tring. (Water Colour).
90	Fir-trees, Kensington Gardens. (Pencil).
91	Study in Chalk.—Farmer's Friend in "Gulliver."
92	Study in Chalk—The Governess.
93	Errand Boy. (Chalk).
	ROBSON, GEORGE FENNELL.
94	Charlton, Kent. (Water Colour).

List of Drawings, &c.—*continued.*

No.	Name of Artist and Subject.	No.	Name of Artist and Subject.
	Simson, W.		Webb, Edward.
95	Eel Pots. (Water Colour).	101	Fish Market, Hastings. (Sepia).
96	Study of a Female. (Water Colour).		
97	Hen and Chickens. (Oil study).		Webster, Thomas, R.A.
	Turner, J. M. W., R.A.	102	Chalk Study for the Principal Figure in the Village Choir.
98	Hornby Castle. (Water Colour).		
	Uwins, Thomas, R.A.		Wilkie, Sir David, R.A.
99	Mercury and Psyche. (Chalk).	103	Coloured Chalk Study for "The Peep of Day Boy."
100	Cupid restoring Psyche to Animation. (Chalk).		

(Signed) John Sheepshanks.

Witness,
Henry Cole.
Richard Redgrave.

21st January 1857.

APPENDIX B.

I.—Annual Inspections and Examinations.

It has been determined to have an annual inspection of the works of each Local School of Art, when an award of medals will take place. Each master will be required to have all the works of the students, executed since the last examination, properly hung, prior to the day notified for the inspector's visit.

As it will be necessary that the drawings rewarded with medals should be transmitted to London before the inspector finally leaves the town, any public exhibition of the works should be made during or *previously to his visit.*

Examinations will take place in freehand drawing, geometry, mechanical drawing, perspective, model drawing, and memory drawing; and a room must be provided in which the inspector can hold them.

Although medals can be awarded only to works executed after the prescribed examples (with the exception pointed out in paragraph 7, form No. 127), the whole of the works executed in the school subsequent to the last examination must be arranged for inspection.

Awards to Local Schools of Art.

For every medal awarded in the national competition, the School of Art in which the successful student who obtained the medal was under instruction, will have the privilege of selecting from a list, works of art of the value of 10*l.* The benefit to every school will, therefore, be proportioned to the advance of the students, and it will be chiefly by such means that that the nucleus of a Local Museum may be established.

Appendix B.

ANNUAL INSPECTIONS AND EXAMINATIONS.

II.

Marlborough House, Pall Mall, London,
_____ day of April 1856.

SIR,

I AM directed by the Lords of the Committee of Privy Council to inform you that they have had under their consideration the wishes of the various Committees of the Schools of Art throughout the United Kingdom, in respect of the periods for holding the annual local examinations of the works of students.

It has been found that whilst many Schools in opposite parts of the kingdom have fixed precisely the same periods as most convenient to themselves, others have appointed times which have no reference to the convenience of the adjacent schools. Thus Aberdeen and Southampton both select the months of April, May and June; and the three adjacent towns of Cork, Waterford, and Clonmel have proposed periods which would require three express journeys of the inspector to Ireland.

Under these circumstances it must be obvious that it has been impossible to meet the exact wishes of every Committee, but the arrangements have been made with the view of doing so as far as possible.

The examination will therefore commence in the _____ school, on Monday, the _____ day of _____, unless any unforeseen circumstances prevent it, but of which you will have timely notice; and I am to request that the arrangements, specified in Circular No. 127, as necessary, may be made in due time.

Your Committee will also learn from this circular that the Board of Trade, in addition to the medals to be awarded to students in the local and national competition, has authorized the presentation of works of art to your school, to be made in proportion to the number of medals obtained by the students.

I am, &c.

The Secretary of the
School of Art, _____

RULES FOR THE PREPARATION OF STUDENTS' WORKS FOR EXAMINATIONS AND PRIZES.

No. 127.

Memorandu on the Annual Awards of Prizes in the Schools of Art.

153. Heretofore there have been two annual exhibitions in London for the purpose of inspecting the works and rewarding the students of the metropolitan and provincial schools. This course was attended with two defects,—first, *all* the works of the various schools were never inspected together; and, secondly, there was no sufficient mode of testing the student's knowledge of geometry, mechanical drawing, perspective, and model drawing. Moreover, the great increase of schools of art throughout the kingdom, and also the number of students attending them, necessitate changes in the mode of inspection.

154. It has been determined, therefore, that once in each year an inspector from the Department shall visit each school of art, and shall hold an examination in certain of the early stages of the course; and at the same time, in conjunction with the head master of the school, and assisted, if necessary, by a head master from one of the nearest schools of art, adjudge local medals and rewards.

155. The principal and advanced works, rewarded with a medal, will be sent to form a general collective exhibition, either in some one of the great provincial towns or the metropolis; and will be inspected by the art superintendent, who, in concert with examiners appointed by the Board of Trade, will adjudge national medals to the best works from all the schools in competition with each other. The collection will afterwards be sent round to some of the larger provincial towns.

162. The *imperial* sheet, *i.e.* 29½ in. × 21½ in., either whole or in halves or quarters, should be the size of all works, whether drawn or painted, and this size must be strictly attended to, since it has been determined to provide frames for the exhibition of works for the national competition, and for their transmission for exhibition to the local schools; all canvasses used should also be half imperial size, viz., 21½ in. × 14¾ in., or imperial size, viz., 29½ in. × 21½ in. Models should conform to the sizes prescribed; they must be backed out as lightly as possible consistently with safety; all round figures kept to the size already stated, and models from the life selected for exhibi-

Appendix B.

PREPARATION OF STUDENTS' WORKS.

tion should, as far as possible, be those treated in low relief, as round figures are more liable to injury in transit.

163. Works glazed cannot be received for the national competition.

164. All works must have a printed label, which will be supplied by the Department, neatly filled in and carefully attached.

165. Masters are particularly required to observe the rules laid down, and to adopt the standard examples prescribed, particulars of which will be found on the other side.

166. The subjects of study in stage 22, sections *b* and *c*, together with the subjects in stage 23, applied design, will be given annually in the "prize lists."

167. Works to which prizes are awarded will, probably, be reserved for six months by the Department, in order that they may be exhibited in a limited number of provincial schools of art; such schools will be selected as make application to receive them, and adequate preparations for exhibiting them to the public.

In arranging the works rewarded with national medals for exhibition in the provincial towns, the Department will reserve a discretion, as to models either in relief or the round, and as to the number of other works that it may be considered desirable to send for that purpose.

When works are required in sets, each set is to be reckoned as one work, and not each separate drawing or painting.

Of the Nature and Conditions of the Awards.

1. Of Local Medals.

1. There will be in each year, in each school, a competitive examination conducted by the inspectors, by means of papers in freehand drawing, practical geometry, mechanical drawing, perspective, model drawing, and memory drawing; and each successful candidate in these branches will be rewarded with a small box of mathematical instruments, works on geometry and perspective, or a box of colours, but no works in this elementary section will be eligible for medals. The students are free to submit themselves or not to this examination.

2. The works in the various stages and sections in drawing, painting, modelling, and design will be examined, in competition with each other, under the following conditions, and local prize medals awarded to them. No local medal can be awarded in any stage or section unless there are sufficient works for competition, nor unless the inspector shall think that the general merit of the works entitles them to reward.

STAGES of INSTRUCTION in SCHOOLS of ART, with the EXAMPLES to be used in COMPETITION for MEDALS.

This Form to be filled up and sent with the Works for Exhibition at the next _____ National Competition from the _____ School of Art.

[Works in those stages or sections marked thus * are eligible for local medals, and to be forwarded to the National Competition. In those stages or sections marked thus ‡ examinations will take place for local rewards, but the works are not to be forwarded for the National Competition.]

STAGES.	Whole No. of works exhibited in the School.	No. that have obtained Medals or Rewards.	No. transmitted to the National Competition.	Examples, &c., to be used by the Students in preparing Works for Competition. These examples will continue the same for 1856-57, except as to Stage XXII.
Linear drawing by aid of instruments: *a.* Linear geometry‡ . . *b.* Mechanical and machine drawing, and details of architecture from copies‡ *c.* Linear perspective‡ . .				STAGE I.
Free-hand outline drawing of rigid forms from examples or copies: *a.* Objects . . . . *b.* Ornament* . . .				STAGE II. *a.* Tarsia. Department No. 256. *b.* Trajan. Frieze, by Albertolli, No. 5; enlarged from $15\frac{5}{8} \times 6\frac{1}{4}$ to $20\frac{1}{2} \times 8\frac{1}{4}$. Department No. 1,271.
Free-hand outline drawing from the "round:" *a.* Models and objects‡ . . *b.* Ornament* . . .				STAGE III. *b.* Lower portion of the pilaster of the gates of the Madeline, two feet high, or marked portions of two pilasters from the tomb of Louis XII., Nos. 460 and 478, to be drawn on the same sheet of paper as one study.
Shading from flat examples or from copies: *a.* Models and objects . . *b.* Ornament*				STAGE IV. *b.* Renaissance rosette, published by the Department, No. 291,—or ancient car from the Vatican; Gruner, p. 14. Department No. 294.
Shading from the round or solid forms: *a.* Models and and objects‡ . *b.* Ornament* . . . *c.* Time sketching and sketching from memory . .				STAGE V. *b.* Ornament from the architrave of the gates of Ghiberti; the egg plant portion, or lower portion of the Florentine Scroll, half size by scale.
Drawing the human figure and animal forms from copies: *a.* In outline* . . . *b.* Shaded				STAGE VI. *a.* Outline of Laocoon. Department No. 597; or outline of Farnese Hercules, No. 501.
Drawing flowers, foliage, and objects of natural history from flat examples or copies: *a.* In outline . . . *b.* Shaded				STAGE VII.

Appendix B.

EXHIBITION OF STUDENTS' WORKS.

STAGES.	Whole No. of works exhibited in the School.	No. that have obtained Medals or Rewards.	No. transmitted to the National Competition.	Examples, &c., to be used by the Students in preparing Works for Competition. These examples will continue th same for 1856–57, except as to Stage XXII.
8. Drawing the human figure or animal forms from the round or nature:				STAGE VIII.
a. In outline from casts* .				*a.* Outline, half size, viz., 1ft. 8 × 1ft. 11½in. of a portion of panathenaic frieze from the P thenon; Brucciani's list, No. B.M. 41,—or the portion No. British Museum, 1ft. 10in. × 1½in., on imperial paper.
b. Shaded*				*b.* The Discobolus of Myron,— Discobolus of Naucydes or Germanicus; size—suitable t sheet of imperial drawing pap
c. Studies of the human figure from nude model*.				
d. Studies of the human figure draped* . .				
f. Time sketching and sketching from memory.				
9. Anatomical studies:				STAGE IX.
a. Of the human figure* .				*a.* The bones and muscles filled the outline of the Discobolus Myron, or the Discobolus Naucydes or the Germanicus.
b. Of animal forms* . .				*c.* Either of the same modelled low relief, size, 21½ in. × 14⅝ in
c. Of either, modelled* .				
10. Drawing flowers, foliage, landscape details, and objects of natural history from nature:				STAGE X.
a. In outline*				*a.* Size of works when mount 21½in. × 29½in.; or 21½in. × 14
b. Shaded*				
11. Painting ornament from the flat or copies:				STAGE XI.
a. In monochrome, either in water colour, tempera, or oil*				*b.* Schools may obtain proper amples in this stage and stage through the Department, ai by grants attached to Natio Medals. If strained canva are used for studies in this st they should be imperial or imperial size.
b. In colours* . . .				
12. Painting ornament from the cast, &c.:				STAGE XII.
a. In monochrome, either in water colour, tempera, or oil*				*a.* Pomegranate and egg-plant tion of the architrave of Ghiberti gates, or Trajan sc half size, Department No. Canvasses used to be imperia half im perial size.
13. Painting (general) from flat examples or copies, flowers, still life, &c.:				STAGE XIII.
a. Flowers or natural objects, in water colour, in oil, or in tempera* .				*a.* See Stage XI.
b. Landscapes . . .				*a.* In tempera—Brooks' studie flowers, or flat tints. Dep ment Nos. 1,536 or 1,539.
14. Painting (general) direct from nature:				STAGES XIV. and XV.
a. Flowers or still life in water colour, in oil, or in tempera* . . .				If on canvass, the size must 29½in. × 21½in., or 21½in. × 14
b. Landscapes* . . .				
15. Painting groups, as compositions of colour.—In water colours, in oil, or in tempera*				

STAGES.	Whole No. of works exhibited in the School.	No. that have obtained Medals or Reward.	No. transmitted to the National Competition.	Examples, &c., to be used by the Students in preparing Works for Competition. These examples will continue the same for 1856-57, except as to Stage XXII.
Painting the human figure or animals in monochrome from casts:				STAGE XVI.
a. In oil or in tempera* .				*a*. Dancing girl with wreath, a high relief in panel—or Germanicus—or Head of Ajax.
Painting the human figure and animals in colour:				
a. From the flat or copies* .				
b. From nature, nude or draped*				
c. Time sketches and compositions . . .				
Modelling ornament:				STAGE XVIII.
a. From casts* . . .				*a*. Portions of low relief panels from the tomb of Louis XII., Nos. 460 and 478,—or nest of the scroll of the pilaster from the Villa Medici, Department No. 473, size, 1ft. 7¾in. × 2ft.; or Trajan scroll,—size, 2ft. 1½in. × 1ft. 7in., Department No. 471.
b. From drawings . . .				
c. Time sketches from examples and from memory.				
Modelling the human figure or animals:				STAGE XIX.
a. From casts or solid examples*				*a*. Bronze Hercules, 2ft. high, or Discobolus of Myron, or Discobolus of Naucydes, in relief, 2ft. high.
b. From drawings . . .				
c. From nature, nude or draped*				
Modelling fruits, flowers, foliage, and objects of natural history from nature.*				
Time sketches in clay of the human figure or animals from nature.				
Elementary design:				STAGE XXII.
a. Studies treating natural objects ornamentally* .				*a*. Ornamental analysis of nature, in sets of 2, viz., one sheet giving the natural growth, and one the ornamental details.
b. Ornamental arrangements to fill given spaces in monochrome* . .				The subjects for Sections *b* and *c* for the year 1857, are the flowers and leaves of the wild strawberry (Fragaria vesca), arranged within a pentagon. For 1858, the flowers and leaves of the yellow crow-foot (Ranunculus bulbosus), arranged within an hexagon. For 1859, the flowers and leaves of the cranesbill (Geranium Robertianum), arranged within an octagon. In each case the inscribing circle of the polygon to be 7in. At least two works are required from each student competing.
c. Ornamental arrangements to fill given spaces in colour*				
d. Studies of historic styles of ornament, drawn or modelled* . . .				*d*. 1857, Studies of Egyptian, Greek, and Roman ornament. 1858, studies of Mahommedan and Indian ornament. 1859, studies of Gothic and Tudor ornament.

Appendix B.

Exhibition of Students' Works.

Stages.	Whole No. of works exhibited in the School.	No. that have obtained Medals or Reward.	No. transmitted to the National Competition.	Examples, &c., to be used by the Students in preparing Works for Competition. These examples will continue the same for 1856-57, except as to Stage XXII.
23. Applied designs, technical or miscellaneous studies: *a.* Machine and mechanical drawing, plan drawing, mapping, and surveys* *b.* Architectural design* *c.* Surface design* *d.* Plastic design* *e.* Moulding, casting, and chasing. *f.* Lithography* *g.* Wood engraving* *h.* Porcelain painting*				Stage XXIII. The subjects in this stage are given annually in the "Prize Lists."

3. No medal can be awarded in any stage or section wherein all the conditions herein laid down have not been *strictly* observed, nor unless the prescribed examples have been used in those stages wherein the examples are defined.

4. The whole number of local medals that can be awarded in any school will not exceed thirty, and in any one stage or section may not exceed three.

5. Medals are only to be awarded to those sections and stages marked with an asterisk.

6. When more than one medal in any stage or section is awarded, the best work in that stage or section is to be considered as having obtained a first medal, and that work *only* is to be forwarded to the national competition. If, however, very great merit and close equality of excellence is evident in *two* works in the same stage—a second may, with the sanction of the inspector, be sent up and reported for *permission* to compete.

7. One medal may be given in each school to the best work *in any one* stage or section which is not conformable to the prescribed example, in those stages where the examples are named, provided that it is a work of great merit and excellence, and does not increase the total number of thirty medals—the work so rewarded will be admissible to the national competition.

8. In applied design, one medal may be given in any or all the various classes of prizes offered in the prize list, provided that the whole number of medals given in the school does not exceed thirty. If a student obtain more than one award in any annual examination, only one local medal will be given—but the several works rewarded (if the best

of their stage or section) are eligible for the national competition.

9. Each work rewarded in the local examinations will be stamped by the inspector, and must be at once forwarded to London, preparatory to transmission for the general exhibition and award of national medals.

10. Neither in the local competitions, nor in the general competition, can a medal be obtained twice by the same person in the same stage, or section of a stage.

2. *Of National Medals.*

1. The works which have obtained first medals in the local competitions, being all collectively exhibited, will be examined by the art superintendent, aided by other appointed examiners, and medals awarded to the works successful in this second competition.

2. These medals can in no case exceed 100 in number for all the schools, but the number up to this maximum will be regulated by the excellence of the collective works.

3. Neither in the local competitions, nor in the general competition can a medal be obtained twice in the same stage or section by the same individual.

4. Each work rewarded in the general exhibition will be stamped by the Department prior to its return.

5. Works sent to the general competition will be retained some time after the inspection, in order that they may be exhibited in some of the principal towns.

Notice to Masters.

Each master will be required to have all the works of the students, executed since the last examination, properly hung prior to the day notified for the inspector's visit.

As it will be necessary that the drawings rewarded with medals should be transmitted to London before the inspector finally leaves the town, any public exhibition of the works should be made *during or previous to his visit.*

Examinations will take place in freehand drawing, geometry, mechanical drawing, perspective, and model drawing, and a room must be provided in which the inspector can hold them.

Although medals can be awarded only to works executed after the prescribed examples (with the exception pointed

Appendix B. Preparation of Students' Works.

out in paragraph 7) the whole of the works executed in the school subsequent to the last examination, must be arranged for inspection.

Awards to Local Schools of Art.

For every medal awarded in the national competition, the school of art in which the successful student who obtained the medal was under instruction will have the privilege of selecting from a list, works of art of the value of 10*l.* The result to every school will, therefore, be proportioned to the advance of the students, and it will be chiefly by such means that the nucleus of a local museum may be established.

No. 232.

Public Examinations in Elementary Drawing.

1. Prizes will be given by the Department of Science and Art for proficiency in elementary drawing, both free-hand and mechanical, and in the advanced stages of art, to all children and adults who pass a satisfactory examination in these branches of useful knowledge. This examination is not confined to students of the school of art or schools taught by certificated masters of the Department, but is open to all, wherever their knowledge has been obtained.

2. The master of the school of art of the locality will receive one shilling for every prize taken in these examinations, provided instruction is given by him, or under his direction, to the person who obtains the prize, to a part or the whole of the children of such parish or public school.

3. Every parish or public school, where it is desired that the children should be examined, must give notice accordingly to the secretary of the Department of Science and Art, London, or the local Secretary of the School of Art. These examinations will take place once in the year, in the respective local schools of art.

4. Adults may attend for examination at any local school of art at the annual inspection of the school, provided they previously signify their intention to the master of the school.

5. The examinations will be of two grades of proficiency, and will consist of the following kinds of elementary draw-

ing—the prizes being given to all who reach a fair standard of excellence.

In the first grade,—

a. A copy from an easy outline, to be executed with lead pencil on paper ; such as Simpson's or De la Rue's outlines, which may be procured of Messrs. Chapman and Hall, 193, Piccadilly, London and all booksellers.—The prize will be a small drawing board and a T square.

b. An outline drawing of an object such as a cube.—The prize will be copies of Grant's geometry, Redgrave's colour manual, and Burchett's definitions of geometry.

c. An outline drawing from memory of a common object of daily use.—The prize will be a pair of compasses, including pen and pencil.

d. Some easy problems in practical geometry.—The prize will be a colour box suitable for colouring mechanical drawings.

In the second grade,—

a. A free-hand outline from a copy.

b. A free-hand drawing from a solid form.

c. A free-hand outline from memory of a common object of daily use.

d. An exercise in practical geometry.

e. An exercise in perspective.

f. An exercise in mechanical drawing.

The prizes in this grade will consist of copies of Burchett's geometry and perspective, a large drawing board and a T square, a box of mathematical instruments, a box of ten colours, with slab, &c., any one of which may be selected by the student.

Appendix B.

CIRCULATION OF BOOKS, &c.

CIRCULATION OF BOOKS, PRINTS, &c., TO LOCAL SCHOOLS OF ART.

Suggestions.

1. The circulation of articles from the central museum of ornamental art, among the local schools having proved quite satisfactory, regulations are about to be adopted by which it is proposed to extend the same principle to the collections of the central library, and by this means to give to the schools of art of the United Kingdom the privilege of sharing in the use of the books of reference, prints, and drawings which have been procured by the Department.

2. It must be obvious that it would be unnecessary to circulate works which are of a low value and easily procured, and also that an unlimited time for returning works would be inconvenient. It is, therefore, intended that no works shall be borrowed which are below the value of [five ?] pounds, and that none shall be kept beyond [four ?] weeks.

3. Before settling what the minimum sum or duration of time should be, committees of schools are requested to state their wishes and send their suggestions to the Department.

4. Every school taking [two or three] local medals in the current year will be entitled to borrow certain works, and in proportion to the number of medals which each school takes in the *national competition* will be extended the privilege of borrowing.

5. In borrowing works local committees must guarantee their security from damage and their safe return. The charges for carriage to the local school must be paid by the committee, but the Department will pay the cost of carriage back.

6. The suggestions should be forwarded to "The Secretary, Department of Science and Art, South Kensington, London (S.W.)," on or before the 1st March 1857.

South Kensington, 13th January 1857.

Name of person forwarding the suggestions _____

Address _____

N.B. This prospectus is forwarded for the purpose of eliciting from those who are interested in the progress of the schools of art, suggestions on certain points of detail, which should be written on the right hand side of the paper.

PHOTOGRAPHS OF OBJECTS IN THE MUSEUM OF ART.

Artists, manufacturers, and the public generally may obtain photographs, both negative and positive, of the objects in the Museum of Ornamental Art, on payment of the following fees :—

For a negative of any object or objects, together with one positive impression, not exceeding 4 inches by 6 inches - - -	10*s.*
Positive impressions, each - - -	1*s.*
For a negative of any object or objects, together with one positive impression, not exceeding 8 inches by 10 inches - - -	20*s.*
Positive impressions, each - - -	3*s.*
For a negative of any object or objects, together with one positive impression, not exceeding 10 inches by 12 inches - - -	30*s.*
Positive impressions, each - - -	5*s.*

Any larger sizes may be obtained by special agreement. Applications for negatives made under Mr. Thurston Thompson's superintendence to be addressed to the Secretary of the Department, Cromwell Road, South Kensington, and for printed impressions only, to Mr. Thurston Thompson, 1, Campden Hill Terrace, Kensington. No orders can be received without prepayment.

EDUCATIONAL MUSEUM under the LORDS OF THE COMMITTEE OF PRIVY COUNCIL ON EDUCATION.

1. To aid all classes of the public in carrying out the work of national education, and especially those engaged in teaching, the Lords of the Committee on Education have arranged to establish at the new buildings at South Kensington, a museum which will exhibit, under a proper classification, all important books, diagrams, illustrations, and apparatus connected with education, already in use or which may be published from time to time, either at home or abroad.

2. It is proposed that the museum shall be opened to the public this spring. The public will be admitted free to the museum as a public exhibition on certain days of the week ; and on other days, which will be reserved for students, opportunity will be given to examine and consult the objects.

Appendix B.

EDUCATIONAL MUSEUM.

3. The objects exhibited at Saint Martin's Hall in 1854, which were presented to the Society of Arts, and by that Society given to the Education Board, in order to found a museum, will form part of the Educational Museum. The producers of apparatus, books, diagrams, maps, &c., used in teaching will have the privilege—subject to certain regulations—of placing their publications and productions in the museum, and thus making them known to the public. A catalogue will be prepared, which will contain the price lists which exhibitors may furnish for insertion.

4. The books and objects will be grouped under the following divisions :—

1. School buildings and fittings, forms, desks, slates, plans, models, &c.
2. General education, including reading, writing, grammar, arithmetic, mathematics, foreign languages, and histories.
3. Drawing and the fine arts.
4. Music.
5. Household economy.
6. Geography and astronomy.
7. Natural history, including geology, mineralogy, botany, zoology, and physiology.
8. Chemistry.
9. Physics.
10. Mechanics.
11. Apparatus for teaching persons of deficient faculties.
    - *a.* Persons physically deficient, such as the deaf, dumb, and blind.
    - *b.* Persons mentally deficient, such as idiots, imbeciles, and the insane.
12. Physical training, or means for promoting the health of the body.

5. In organizing the museum, the Committee on Education hope to have the co-operation of all who are interested in the object.

Books, diagrams, maps, apparatus, &c., intended for the museum, may be addressed to the Secretary of the Department of Science and Art, Cromwell Road, South Kensington, London (S.W.), care of Mr. Richard Thompson, Superintendent of the Museum.

REGULATIONS for the GUIDANCE of CONTRIBUTORS to the EDUCATIONAL MUSEUM.

1. The museum will be open free to the public on Mondays, Tuesdays, and Saturdays; and on Wednesdays, Thursdays, and Fridays to students and the public generally, on payment of 6*d.* each, or a subscription of 10*s.* a year, or 5*s.* a quarter, payable in advance.

2. Contributions forwarded for exhibition will be classified and arranged by the officers of the museum.

3. Exhibitors will be requested to attach descriptive labels, giving the names, uses, &c., to their contributions; the size and form of such label to be hereafter determined.

4. It is desirable that the usual retail price should be distinctly marked on all articles sent for exhibition.

5. As it is the wish of the Committee on Education, and the evident interest of exhibitors, that the museum should at all times represent the then existing state of educational appliances, every facility will be given for the introduction of new inventions, books, diagrams, &c., relative to education.

6. Books and other educational appliances out of date, or the utility of which may have been superseded, or articles that may have become injured, may be removed or replaced at the option of the exhibitor.

7. To prevent confusion and the possibility of articles being removed by persons not properly authorized by the exhibitor, due notice in writing of the intention to remove articles must be given, and no book or object is to be removed until it has been exhibited at least twelve months.

8. In order to protect the property of exhibitors, no article will be allowed to be removed from the museum without a written authority from the Superintendent.

9. On Wednesdays, Thursdays, and Fridays, the books and other objects in the museum will be open to students and to the public for inspection and study, under such regulations as are usually found convenient in a public library.

10. A catalogue will from time to time be published, so as to keep pace as much as possible with the additions to the museum and the withdrawals from it.

11. Exhibitors desirous of advertising in the catalogue may send their prospectuses, illustrations, price lists, &c., 1,000 copies at a time, and *printed in demy 8vo.*, so that they may be bound up in the catalogue. The binding will

Appendix B.

REGULATIONS FOR THE GUIDANCE OF CONTRIBUTORS.

be free of cost to the exhibitor; but exhibitors will bear any depreciation in the value of the objects from their use by visitors.

12. All contributions forwarded to the museum to be addressed to the Secretary of the Department of Science and Art, Cromwell Gardens, South Kensington, care of Richard A. Thompson, Esq., Superintendent of the museum.

EMPLOYMENT OF FEMALE TEACHERS IN PUBLIC AND PRIVATE SCHOOLS.

(I.)

The Lords of the Committee of Privy Council for Education being desirous of promoting art education by means of female teachers are prepared to recommend ladies who have taken certificates of competency in the department of art.

The instruction embraces all kinds of drawing, painting, and modelling, together with practical geometry and perspective.

The following are the fees officially recommended:—

For Public Schools.

One hour's lesson per week given in a public school to any number of children, not exceeding fifty, among whom there may be pupil-teachers—5*l.* per annum, payable half-yearly.

For Private Schools.

One hour's lesson at 7*s.*, or two hours for 10*s.*

For Private Classes or Pupils.

A single pupil 3*s.* 6*d.* for one hour's lesson, or 5*s.*, for two hours. For two or more pupils the fee will be reduced one-third for each.

NOTE.—If the place where the lesson is to be given exceeds one mile from South Kensington, omnibus or railway fares must be paid in addition; and should the journey to and from exceed one hour, an extra charge of 2*s.* 6*d.* an hour, or of such other sum as may be agreed upon, must be allowed.

The necessary examples and materials may be procured of Messrs. Chapman and Hall, 193, Piccadilly, London (W.), at a reduction to all schools of fifteen per cent. on the published list.

(II.)

Female Teachers.

The female teachers in the training school attain great excellence, and take high class certificates in geometry, perspective, free-hand drawing, painting, &c.; but there seems some public apathy in engaging their services, arising, perhaps, from the doubt of a lady's ability to teach drawing rigidly and precisely.

I think the Department might properly undertake to recommend the female teachers for public or private teaching at fixed rates, and that the certificate allowances should be made as long as the teachers give instruction according to the rules of the Department, and in sufficient amount.

21st Jan. 1857.

APPENDIX C.

ANNUAL REPORT of the DIRECTOR-GENERAL of the GEOLOGICAL SURVEY of the UNITED KINGDOM, the MUSEUM of PRACTICAL GEOLOGY, and the SCHOOL of SCIENCE applied to MINING and the ARTS.

Geological Survey of the United Kingdom.

GREAT BRITAIN.—Taking into consideration the fact, that the returns have this year been made three months earlier than in the year 1856, and that this report can, therefore, refer to nine months only of work completed, the results of all kinds which have been elaborated under the supervision of the Local Director, Professor Ramsay, are equal to those of any previous year.

Maps illustrating the structure of the Isle of Wight, and other parts of Hampshire, as well as of Wiltshire, Dorsetshire, Gloucestershire, Oxfordshire, and Warwickshire, have been published, comprising an area of about 2,357 square miles, whilst other sheets relating to two of the above mentioned counties, Wilts and Gloucester, and also to Berkshire, and the northern portion of Staffordshire, are on the point of being issued, and amount to 996 square miles.

The area surveyed in England and Wales for the construction of new maps, consists of large portions of Kent, Sussex, and Surrey, in addition to other parts of several of the above-named counties, and, including parts of Scotland, embraces about 1,149 square miles of districts, wherein there exist so many sub-divisions of the oolitic, wealden, cretaceous, and tertiary groups, which are complicated by faults and ramifying vallies, that the area delineated gives but an imperfect idea of the labours necessarily performed on foot by the Surveyors, Messrs. Bristow, Hull, and their associates, who have traced such boundary lines over many hundred miles.

Additional boundarylines have been traced in Wales, according to the wishes of my predecessor, Sir Henry De la Beche, and I have examined in person some essential portions of this work accompanied by Professor Ramsay and the Surveyor, Mr. W. Talbot Aveline, whose labours have been most successful throughout that difficult region.

The accompanying coloured skeleton map (A.) explains at a glance the area of England and Wales, of which the Geological maps have been published, as well as of those tracts that have been surveyed or are in course of examination.

In Scotland the survey has made all the progress compatible with the present small staff of two Geological surveyors only. The work, commenced in the environs of the metropolis, is far advanced towards completion as respects the counties of Edinburgh and Haddington, the six-inch maps of which have received, or are

Appendix C.

REPORT OF DIRECTOR-GENERAL OF THE GEOLOGICAL SURVEY.

about to have applied to them, the Geological outlines of the coal fields and their associated deposits, whether Silurian and Old Red Sandstone or eruptive rocks. (*Vide* skeleton map B.)

It is well here to observe, that whilst the labours of the Geologists in Scotland are much facilitated by the possession of maps on the scale of six inches to the mile, on which all minutiæ can be readily registered, such knowledge cannot be communicated to the public until the general or one-inch Ordnance map of each district be issued. As there is every reason to believe that such general maps will soon be completed, it is hoped that the Geological maps may keep pace with them, provided the number of surveyors in our own department be adequately augmented.

The larger part of England and all Wales never having been surveyed and mapped on the six-inch scale, the duties of the geologists in Great Britain have been confined to the delineation of the rocks on the one-inch published maps. In directing public notice to this point, it is my duty to state, that some of the old maps of the South West of England, particularly those of Somerset and Devon, are so defective and so inferior to the subsequently published maps of Wales and the central counties of England, that the Mining Geologist of this establishment has found it impossible to lay down accurately the course of those various rich lodes of iron in the districts of North Devon and Somerset, which of late years have deservedly attracted attention.

Horizontal sections have been levelled over 301 miles, and these, with the exception of short distances in the Isle of Wight and Dorsetshire, will chiefly illustrate the coal fields and surrounding formations in the central counties of England, and thus throw light on the distribution of coal under the overlying red rocks, whether of Permian or Triasic age.

The rate of progress which the Geological Survey of England can make with its present staff being now well ascertained, and it being manifest that, without more aid, a long period must elapse before the important mining districts of the northern counties, already mapped geographically, could be reached, I have this year applied for the appointment of two additional surveyors. It is hoped, therefore, that before the close of the year 1857, the work in progress in the southern counties and around the metropolis will be so far advanced, that the lines may be carried northward into the Lancashire, North Derby, and Yorkshire coal fields.*

IRELAND.—Notwithstanding the unusually stormy weather during the last summer, which impeded field work in Ireland, and particularly in the South western counties, the Local Director, Mr. J. Beete Jukes, reports that 1604 square miles of country have been surveyed, with the six-inch maps in hand, in the counties of Kerry, Cork, Limerick, Kilkenny, and Queen's and King's counties; and that sections have been run along 417 miles of wild and rugged coasts.

* For the details of the labours of the Survey of Great Britain, *see* Table 1.

Having myself recently visited the different parts of Ireland in which the surveyors are now engaged under the direction of Mr. Jukes, I can bear testimony to the zeal and attention with which these gentlemen are executing very onerous duties, performed at great risk of health, and often under many privations. The accompanying index map (C.) shews the state of the field survey on the six-inch map; all the documents relating thereto being preserved in the Geological Survey Office, Dublin. In many of these sheets every undulation or break of the strata is laid down with minute accuracy.

Accompanying these maps are copious collections of rock and fossil specimens, which when examined and named will be placed in the mineral division of the Museum of Irish Industry.

An unavoidable delay has occurred in the publication of the new one-inch maps. In my last Report it was stated that, as very large tracts of Ireland were covered by broken materials and gravel, the presence of which was often of great value to the landed proprietor, it was desirable to mark as far as possible, the range of such loose materials over the surface of the fundamental rocks. An ingenious contrivance for stippling the paper representing the area covered by such gravel, as proposed by Captain Leach, R.E., of the Ordnance Map office, having been found to present difficulties, the same officer has now produced an engraved character which perfectly answers the end, and four of the quarter sheets have been issued to the public.

The accompanying index map of Ireland (D.) shows the whole state of the geological one-inch map at the present date. It is hoped that these coloured skeleton maps, showing the annual progress made by the survey, and which are now, for the first time, appended to the Report, will supply all the information which has been called for during the two preceding sessions by the House of Commons, thus occasioning a second report.

Whilst the Irish Geological Survey consists of a Local Director and seven Surveyors, with two collectors of fossils, and a Museum exists in Dublin where it is justly expected that the whole of the materials collected for the illustration of the maps should be arranged in a manner similar to that of the Museum in Jermyn Street, it has been found impossible to accomplish this result by the desultory and limited examination which can be given to such remains by an occasional visit of a Palæontologist, sent from the head quarters in London. The Local Director has repeatedly called my attention to this great deficiency of the Irish establishment, and from personal observation I am prepared to state that his request for continuous and systematic assistance is most reasonable. Although the Irish collections have been increasing at the rate of several thousand specimens per annum, no general examination of them has been made for the last eight years; nor, indeed, any examination at all, except of a partial and necessarily imperfect nature, even when conducted by the late lamented Professor E. Forbes. Mr. Salter now alone executes the duties of Palæontologist of the United Kingdom.

The delay of inspecting, examining, and naming the fossils, on

the right performance of which the accuracy of our maps, or the publication of our memoirs and sections, can alone be attained, is truly a serious obstruction to the progress of the geological survey. Fossils, for example, which were collected some years ago, and sent up to Dublin, as illustrating the six-inch maps, have remained unpacked, and being unknown are not available for the correction of the outline of the new one-inch map. Fully impressed with the dependance, to a great extent, of all accurate delineation of geological maps and sections, upon the presence and advice of a naturalist versed in such fossil evidences, and seeing that Ireland possesses as many surveyors and collectors as England and Wales have had up to this time, it is evident that her geological staff ought to be rendered complete and effective, either by the appointment of a Palæontologist exclusively devoted to the purposes of the Irish survey, or by the nomination on the general establishment of the United Kingdom, of such ano fficer, whose time should be mainly devoted to the sister country.

Geological Survey of the United Kingdom.—It must be recollected that, in a very short period, the new Industrial Museum of Scotland, in which the Geological Survey will have an office wherein to exhibit the maps, &c., will doubtlessly call for palæontological illustration. These desiderata are rendered still more obvious by the fact that Mr. Salter, the Palæontologist of the Survey, has stated in strong terms the impossibility of carrying on his labours without the appointment of another officer; and as my report of last year expressed the opinion that his occupation was much too heavy and onerous to be placed as a charge upon one individual, it is earnestly hoped that this state of things may soon be remedied.

The Palæontologist has made good progress during the past year in working up and classifying the great mass of hitherto undigested materials in store from the border counties of Wales, the Oolites of Gloucestershire, and the Tertiary strata of the Isle of Wight. Of these last nearly 11,000 species have been named by the temporary assistant, Mr. Sharman, and subsequently revised. In all, 15,055 British specimens, and 545 foreign specimens have been classified; and of these 742 (as appears by the report of Mr. Huxley) have been placed in the cases of the Museum.

Besides a Decade on Echinoderms, hereafter to be adverted to, steps have been taken to secure the publication of one on Trilobites, and of another on the large extinct Crustaceans (Pterygotus), so characteristic of the Silurian rocks.

Demonstrations explanatory of the characters of the chief organic remains have been given to the students; and in addition to his duties in the cabinet, Mr. Salter has performed useful services in the field. He assisted in the survey of the west coast of Ireland; where, from personal inspection of the ground during the last summer, I willingly record that his labours were productive of conclusions which, in a complicated and contorted country, could not scarcely have been arrived at without palæontological discrimination *in situ*.

Coast Survey.—The coast survey has been carried on, during the months of September and October, by Mr. Huxley, the Naturalist, who was also engaged in completing the examination of the shores of the Bristol Channel. The result of these examinations would have already been reported upon in two memoirs, to a great extent prepared, the one "On the most Recent Changes of Level of the Bristol Channel;" the other, "On the Condition of the Fisheries of the Bristol Channel," had not the necessity for his occupation in the immediate preparation of a catalogue of the fossils in the Museum (reported upon under another head) interfered with their production.

During the session Mr. Huxley delivered a course of 50 lectures upon General Natural History.

Mineral Survey.—The Mining Geologist, Mr. Warington W. Smyth, having visited some of the iron-producing districts of the northern counties of England, has furnished notes upon the stratigraphical relations and mineral characters of the associated rocks, which have been published in a volume on the "Iron Ores of the North and North-Midland Counties of England," hereafter to be mentioned. The same officer has also examined and mapped the geology of the coal-field of Nottingham, thus completing the south-eastern portion of the valuable coal-tract of Derby, to the character and importance of which increased attention will be paid, in consequence of the improved outlets for coal, and of the light which will be thrown on its continuation under overlying formations by the spirited trial of the Duke of Newcastle, near Worksop. This is, in fact, among the British coal-fields, one of the most noticeable for a probable future supply of coal, where no indication of its existence is offered at the surface; and his Grace may be considered a national benefactor for incurring the heavy expense of proving the commercial value of the coal measures, which, though inferred by geological reasoning to exist, needed actual sinkings for the determination of their character.

At the same time quarter-sheets relating to the coal-fields of the Potteries (North Staffordshire) were duly examined and prepared for publication.

Mr. Smyth further visited the Exmoor district of North Devon and Somerset, to collect materials for the work on British iron ores.

During the session of the school, Mr. Smyth delivered a course of 60 lectures on mining and 40 on mineralogy, besides a course of six evening lectures on mining to the working men.

Mining Record Office.—The Keeper of the Mining Records, Mr. Robert Hunt, has, during the past year, been chiefly engaged in extending and improving the organization for obtaining current returns of the mineral produce of the United Kingdom. He has visited various tracts of Staffordshire, Derbyshire, Durham, Lancashire, Cumberland, and Northumberland, as well as those districts in Scotland most rich in coal, lead, and iron, and has also obtained correct returns of the produce of salt in Cheshire and

Appendix C.

Report of Director-General of the Geological Survey.

Worcestershire. He has further procured on the spot many additional data respecting the most extensive quarries of stone in Scotland, and of slates in North Wales; thus enabling him to prepare a more correct return of such produce in 1856 than had been obtained in any previous year.

The result of inquiries was the publication, in July last, of that volume of the Memoirs of the Geological Survey entitled "Mineral Statistics of the United Kingdom of Great Britain and Ireland for 1855," a work which has given great satisfaction to the public; and by reference to which it will be seen that the returns of 1855 confirm the general exactness of those of 1854.

In extending the original objects for which the Mining Record office was established as an essential ancillary to the Geological Survey, many new plans and sections of mines (as specified in the List 2) have been added to the documents already registered, including the plans of the Mines of Greenwich Hospital, Alston Moor, &c., which were liberally granted by the Commissioners of that Royal Hospital.

The most decisive evidence of the usefulness of amassing such mining records has been shown in the fact that a recent order of the House of Commons to furnish "A Return of the Quantities of Coal, Iron Ore, Copper Ore, Lead Ore, Tin Ore, Silver, Zinc Ore, Salt, and other Minerals raised in each of the Mining Counties of the United Kingdom for the years 1854 and 1855 respectively," was instantly complied with.

As the importance of such returns must depend upon the extent of accurate information which is gathered together, it gives me pleasure to state that the requisite knowledge, so difficult to be obtained in a free country, has been collected not only, by the persevering industry of Mr. Robert Hunt, but specially through his influence with the persons engaged in mining industry, whose friendship has been secured by his conciliatory manner.

Museum of Practical Geology.

The lists which are appended (3 and 4) of the numerous donations to the Museum and Library show the interest the public continue to take in this institution. Amongst them will be found a very valuable and instructive series of specimens illustrating the art of Mosaic from the earliest period to the present time, presented by the Cavaliere Barberi of Rome.

Attention is also directed to the number of visitors, amounting to 20,415, an increase of 7,328 over the numbers of the preceding year, no doubt partly attributable to the augmentation in the number of days on which the Museum is now open to the public.

A great amount of labour having been necessarily imposed upon the Assistant Naturalist, Mr. Baily, in order to free the stores of the Museum from duplicate specimens of fossils, which, though useless to this establishment, were much coveted by other public institutions, the result has proved most satisfactory. Upwards of 7,000 specimens of Palæozoic fossils have been already arranged in 22 sets of duplicates, belonging to all the older formations, from

the Silurian to the Permian inclusive. These will be distributed among colonial and provincial museums, and it is hoped that in a few months the labour will be completed as regards the Secondary and Tertiary fossils for similar purposes.

The catalogues explanatory of the contents of the Museum, including rocks, minerals, metallurgical specimens, ores, and fossil remains, which were announced as being in the course of preparation last year, are now nearly completed, and would have been issued had it not been indispensable to ascertain, in the first place, the real amount of materials accumulated, by the examination of all the stores out of which duplicates could be extracted; such examination necessarily augmenting and improving the chief collection. A popular guide to the whole contents of the Museum is also in preparation.

More extensive or systematic catalogues of the palæontological collection will follow, under the supervision of Mr. Huxley, embracing lists of British fossils in each formation, with their synonomy, and accompanied by appropriate references to the works in which they have been described. The Assistant Naturalist has, indeed, already taken the preparatory steps for such a work.

Metropolitan School of Science applied to Mining and the Arts.

This report, being made up to the 31st December only, does not include the number of students' entries during the whole session, which is divided into two terms, the one commencing in October and the other in February. The entries, therefore, of the first term only can now be stated.

Thirty-five students have been registered to the lectures. Of these seven have paid the fees for the courses, extending over two years as matriculated students. Of the remainder, or occasional students,

21 have entered to the courses on Chemistry.
7 „ „ Physics.
7 „ „ Mining.
7 „ „ Metallurgy.

The courses on Mineralogy, Geology, Natural History, and Applied Mechanics have not yet commenced.

Short courses of lectures have been given as usual in the evening to working men, which are arranged so as to illustrate, within the period of two years, the seven principal branches of science taught at the institution. Those for the present session include—

Natural History - by T. H. Huxley, F.R.S.
Geology - - by A. C. Ramsay, F.R.S.
Applied Mechanics - by Robert Willis, M.A., F.R.S.

Great interest continues to be taken by the working men in these lectures.*

From the fees received during the previous session, 90*l.* 15*s.* 5*d.* have been paid into the Exchequer.

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* The first course of the session, by Mr. Huxley, commenced on the 12th January, and the whole of the tickets (600) were immediately applied for.

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REPORT OF DIRECTOR-GENERAL OF THE GEOLOGICAL SURVEY.

Chemical Laboratory.—Dr. Hofmann, the lecturer on Chemistry, reports that the branch under his superintendence has made great progress in the past year, and that the number of students in the chemical laboratory is larger than that of former years, whilst the researches of several of the advanced students have been thought worthy of publication.

Abstracts of important researches carried on at the Royal College of Chemistry, by Dr. Hofmann and M. Cahours, have been communicated to the Royal Society, and another memoir proceeding from the same laboratory, and prepared by the lecturer and Dr. Buckton (upon the action of sulphuric acid on the amides and nitriles) has been published in the "Philosophical Transactions."

Among the practical researches performed in 1856, may be quoted an examination of the oil of the Aragodo pear, which grows exclusively in Trinadad, as carried on at the suggestion of the Governor of that Island, Admiral Sir Charles Elliot. The experiments show that this oil is a highly valuable product, and that a lasting benefit to the colony may be derived from a plant hitherto neglected.

Light has also been thrown on the important national question of the sewage of large towns, and particularly upon the de-odorizing process by lime. Several minerals, rocks, and mineral waters have been examined and reported upon for the Museum.

Dr. Hofmann has also successfully concluded an enquiry suggested by the Board of Trade, into the best mode of so treating plaster casts as to render them impermeable to water, the plan resulting from his experiments having perfectly satisfied Mr. Theed, the sculptor.

Great inconvenience having been felt by both the chemical lecturer and his students, in continually passing from the laboratory in Oxford street to the lecture-theatre in Jermyn street, with much loss and derangement of the apparatus after every lecture, and considerable annoyance being occasioned to the visitors and officers of the Museum, as well as a deleterious action exercised upon the minerals and models, resulting from the fumes necessarily accompanying chemical experiments, it became my duty to represent these facts to the President of the Board of Trade. Having, in conjunction with Dr. Hofmann, further pointed out to Lord Stanley, of Alderley, that a vacant space behind the college of chemistry might conveniently be converted into a theatre perfectly adapted to chemical illustrations, and close to the laboratory in which the students were usually engaged, his Lordship submitted the matter to the Lords of the Treasury, and the project has, by their orders, been most successfully carried into effect by the Board of Works. The new theatre, erected under the guidance of Dr. Hofmann, will accommodate about 250 persons and is certainly not inferior to any similar establishment either in this country or on the continent.

An extended course of eighty lectures on inorganic chemistry, and twenty on organic chemistry, were delivered by Dr. Hofmann during the session, and a course of six evening lectures, upon the first principles of chemistry, to the working men.

Return of students attending the chemical laboratory :—

	1855.	1856.
Spring session - - - -	32	31
Summer session - - - -	38	31
Winter session - - - -	34	46
Totals -	104	108

Metallurgical Laboratory.—In this laboratory, which forms an annex or wing of the Museum building, Dr. Percy announces a steady and satisfactory progress in the performance of numerous analyses, and particularly those of British iron ores. In alluding to the services of Dr. Percy it is but right the public should be informed that he employs one assistant at his own cost ; and that he pays out of his own private funds for various materials, apparatus, and other expences of the laboratory. Investigations and analyses of great value, conducted under his supervision, have been partially made known, and will soon be given to the public. Students who have passed the metallurgical examination with credit, and who are anxious to devote themselves to enquiries of special interest, have been permitted to work gratuitously in the laboratory, and have produced results very creditable to themselves, and of great value to the lecturer. Dr. Percy has always afforded information concerning ores and various subjects in metallurgy without charge.

The publication in the Memoirs of the Geological Survey of the analyses of British iron ores, being the result of several years of well-methodized researches, has proved, as was anticipated, highly satisfactory.

Besides directing the studies of his students in the laboratory, Dr. Percy has, during the past session, delivered a course of fifty lectures on metallurgy, and six evening lectures on metals to the working men.

Return of Students attending the Metallurgical Laboratory :—

	1855.	1856.
Spring session - - - -	6	9
Summer „ - - - - -	10	8
Winter „ - - - - -	8	7
	24	24

Printed Works.—The recent publications of the Survey are as follows :—

British Organic Remains, decades V. and VIII.; Mineral Statistics for 1855; The Iron Ores of the North and North Midland Counties of England; The Tertiary Fluvio-marine formations of the Isle of Wight.

Of these, it is superfluous to say that, the Memoir on the Isle of Wight, by the late Professor Edward Forbes—brought up as it has been to the existing state of knowledge by Mr. Bristow, as regards the natural sections and mapping of the tract; by Messrs. Morris, Salter, and Rupert Jones, as respects the organic remains,

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—
Report of Director-General of the Geological Survey.

and the whole collated by Mr. R. Godwin-Austen—is a production of singular merit which, while it develops the nature and contents of certain tertiary strata hitherto unrecognized in Britain, offers a masterly delineation of many other geological features of that interesting island.

The Decades of British Organic Remains will, it is trusted, be found to sustain the well-earned reputation of the authors. Decade VIII. on Fossil Fishes, has been gratuitously contributed by Sir Philip de Malpas G. Egerton, Bart., M.P., who, as is well known among men of science, is the Englishman best qualified to describe the true character of Ichthyolites. Decade V. (the last published) on Fossil Echinoderms, is the joint production of Mr. Salter, assisted by Dr. Wright of Cheltenham, and Mr. Woodward of the British Museum. This work has supplied a vacuum in the Decades created by the death of Professor E. Forbes, who had undertaken the task. The plates, executed by Mr. C. Bone, the draughtsman of the establishment, cannot fail to be generally admired.

The useful volume of "Mineral Statistics, collected by Mr. R. Hunt, and the instructive work on "The Iron Ores of Britain," by Dr. Percy and Mr. Warington Smyth, have been mentioned under the respective heads of Mining Records and Metallurgical Laboratory.

Having given directions that the publication of each sheet of the "Geological Survey" should be accompanied, as far as possible, by brief printed notices of the principal data upon which the boundaries of the respective formations have been determined, I may state that the first of these works, which is on the point of being published, is to illustrate Sheet 44, or the country around Cheltenham, by Mr. E. Hull. This Memoir, in demonstrating the close researches of the author, goes far beyond that brief description of a map which was called for, and forms indeed a valuable volume. It must not, however, deter other Surveyors from supplying a simple record of the natural sections and organic remains, which have afforded the principal data in determining the geological lines of their published maps.

Referring to this establishment as a whole, and recognizing the highly useful services of Mr. Trenham Reeks in enabling me to superintend it, I have sincere satisfaction in recording the merit of this experienced and zealous officer.

In speaking of the general influence of the School, it is right to notice that, in consequence of the suggestion of Mr. G. Brand, late Her Majesty's Vice Consul in the Province of Angola, and of a subsequent letter from Her Majesty's Secretary of State for Foreign Affairs, the lectures given in this establishment are now open to all Diplomatic and Consular servants of the Crown on the same terms (*i. e.*, half the usual charges) as apply to the officers of Her Majesty's army and navy, and those of the Hon. East India Company.

One of the gratifying effects of our proceedings is the manner in which Professor Oldham, formerly Local Director of the Geological Survey of Ireland, is carrying out similar operations in

India, supported by officers, most of whom were trained in our service; whilst it is most encouraging to know that Lord Canning, the present Governor-General, has given his cordial support to geological researches, so long neglected, and yet so essential to the well-being of the British Empire in India, and has established at Calcutta a Museum of Practical Geology, and a laboratory on the same principle as our own.

The survey of our West Indian Colonies has commenced, and some progress has already been made in the examination of Trinidad, as conducted by Mr. G. P. Wall, one of the pupils of this school. Applications are also spoken of for the recommendation of qualified persons for other colonies, including Van Diemen's Land or Tasmania.

The theatre of the Museum in Jermyn Street will, doubtless, be well filled in the ensuing session, when, according to an arrangement between Her Majesty's Government and the Trustees of the British Museum, Professor Owen will deliver a course of lectures upon fossil vertebrata. Although the leading objects of a school of mines and an acquaintance with the great facts of stratigraphical geology are attainable without referring to many of the extinct mammalia, still these lectures, resting upon data which are essential to the full acquirements of every philosophical geologist, must prove most advantageous to our Museum, the truly useful character of which will be rendered evident to every one who, attracted by the eloquence of so great a naturalist, will have the opportunity of studying our collections, and thus be led to appreciate our courses of instruction.

In the last Report various examples of the uses which Her Majesty's Government may make of this institution were given. During this year another application, on a subject relating to practical geology, has been made by the Lords of the Admiralty, who have consulted me as to the expediency of proceeding with an expensive deep well-sinking in the dockyard at Portsmouth; and a Report, founded on the experience of other sinkings, and an examination of the strata passed through, recommended a discontinuance of the operations.

In conclusion, it is gratifying to note the augmenting interest taken by the public in the works of the Geological Survey—the leading feature of our labours—*as proved by the great increase in the sale of the maps and sections, which in the past nine months nearly doubles that of any entire preceding year* (*see* Table 5); and now that arrangements have been made by the Lords of the Treasury for the sale of these maps at an uniform rate of charge, there can be no doubt that this simplification will cause a still greater issue, to be again largely increased when the survey shall be carried further into the productive mineral districts of the kingdom.

Roderick I. Murchison,
Director-General.

Appendix C.

REPORT OF DIRECTOR GENERAL OF THE GEOLOGICAL SURVEY.

TABLE I.—GEOLOGICAL

TABLE showing WORK done from

1. No. of Map Sheets.	2. Counties.	3. Formations.
One-inch Scale.	ENGLAND.	
6	Parts of Kent and Surrey	Cretaceous and tertiary
8	,, Surrey and Hants	Ditto
10	,, Hants (Isle of Wight).	Wealden, cretaceous, tertiary
11	,, ditto	Cretaceous and tertiary
12	,, Hants and Surrey	Ditto
13	,, Berks and Oxon	Oolite, cretaceous, and tertiary.
14	,, Wilts and Hants	Oolite, purbeck, wealden, cretaceous, and tertiary.
15	,, Dorset and Hants	Ditto
16	,, Dorset	Ditto
17	,, ditto	Purbeck
34	,, Wilts, Gloucester, and Berks.	Oolite, cretaceous, tertiary
35	,, Wilts & Gloucester	Oolite
44	,, Glocester & Oxon	New red sandstone, lias, oolite.
45 S.W. & S.E.	,, Warwick and Oxon	Oolites
53 S.W.	,, Warwick and Oxon	New red sandstone, lias, oolite
41, 42 N.W.	,, Caermarthen, Brecon,	Silurian
56 N.W. N.E. S.W.	,, Radnor, Salop,	
60 N.W. N.S.	,, Montgomeryshire,	
74	,, Merioneth, Caernarvon, and Denbigh.	
72 N.W.	,, N. Staffordshire	Coal measures, permian, new red sandstone, and lias.
73 N.E.	,, Stafford and Cheshire.	Ditto
62, 63, 71, 72, 73	,, Cheshire, Stafford, Warwick, Leicester, Derby, Nottingham.	Cambrian, carboniferous, new red sandstone, and lias.
74, 79	,, Denbigh and Flint.	Silurian, carboniferous, limestone, coal measures, and new red sandstone.
78	,, Anglesey	Cambrian, silurian, old red sandstone, carboniferous, limestone, coal measures.
Six-inch Scale.	SCOTLAND.	
8, 9. 13, 14	,, Haddingtonshire	Carboniferous, limestone, and coal measures
1, 2, 3. 5. 7, 8. 11, 12, 13, 14. 18, 19.	,, Edinburghshire	Silurian, old red sandstone, carboniferous, limestone, and coal measures.
5, 6. 11, 12. 17	,, ditto	Ditto

SURVEY OF GREAT BRITAIN.

25th February to 31st December 1856.

4. Areas published, 1856.	5. Areas engraving.	6. Areas surveyed complete.	7. Areas commenced and advanced.	8. Areas inspected.	9. Horizontal Sections levelled.	10. Vertical Sections, measured, &c.		11. Vertical Sections engraving.
Square miles.	*Square miles.*	*Square miles.*	*Square miles.*	*Square miles.*	*Miles.*	*No.*	*Feet.*	*Sheets.*
..	..	54	..	..	..	.	..	..
..	..	138	52	23	..	.	..	..
150	..	58	..	150	31½	.	1,230	1
..	..	..	324	..	..	.	..	..
..	..	62	..	27	..	.	..	..
..	..	230	35	..	..	.	..	..
696	..	..	..	..	..	.	..	..
682	..	..	..	..	..	.	..	..
..	..	..	..	..	26	.	194	1
..	..	5	..	..	..	.	..	..
..	672	190	..	672	..	.	..	..
..	..	26	..	..	..	.	..	..
654	..	..	..	..	..	.	..	..
..	..	11	..	..	..	.	..	..
175	..	..	..	..	..	.	..	..
..	..	150	..	..	..	.	..	..
..	156	..	..	..	..	.	..	..
..	168	..	..	..	..	5	..	..
} ..	..	..	..	..	168½	.	..	3
} ..	..	..	..	..	32	.	..	..
..	..	..	..	..	37	.	..	..
..	..	56	..	..	..	3	..	..
} ..	..	169	..	100	6	13	..	..
..	..	..	[52	..	..	.	..	..
2,357	996	1,149	463	972	301	21	1,324	5

AND. C. RAMSAY, *Local Director for Great Britain.*

Appendix C.

PLANS OBTAINED FOR MINING RECORD OFFICE.

II.

DOCUMENTS added to the COLLECTION in the MINING RECORD OFFICE during the year ending December 1856.

1. Providence Mines, plan of workings.
2. do. longitudinal section.
3. do. do.
4. North Huel Unity, plan.
5. St. Ives Consols, do.
6. do. section.
7. Rosewarne and Herland United Mines.
8. Map of West Cornwall Mining Districts.
9. West Alfred Consols, plan.
10. do. longitudinal section.
11. Treloweth Mine, plan.
12. do. longitudinal section.
13. Huel Prosper, do.
14. West Huel Alfred, plan.
15. do. longitudinal section.
16. Huel Buller, plan.
17. Rosewarne United Mine.
18. Lanarkshire coal-field, section.
19. Iron mine, Ulverston, plan.
20. do. do. section.
21. North Huel Busy, plan.
22. do. horizontal section.
23. do. longitudinal do.
24. South Roskear, plan.
25. do. section.
26. Pendarves Consols Mine.
27. Huel Prosper, Moor Lode, section.
28. do. Cross Cut Lode, do.
29. do. transverse section.
30. do. part of cross-cut lode.
31. Great Huel Fortune, longitudinal section.
32. do. (Ludgran) do.
33. Huel Kitty do.
34. do. transverse section.
35. Hallamaning, plan (7 sheets).
36. do. section.
37. Huel Carpenter, plan.
38. do. section.
39. Penberthy Crofts.
40. South Crenver, plan.
41. do. section.
42. Huel Harriet, plan.
43. do. two sections.
44. Caroline Huel Prosper, plan.
45. do. section.
46. Plumtree Colliery, section of strata.
47. Petropavlovskay Gold Mine.
48. Frolovskav Mine.
49. Vexissiliefsxov Mine, &c.
50. Huel Tolgus, Old Lode.
51. do. South Lode.
52. do. plan.
53. do. do.
54. do. South do.
55. do. do.
56. United Mines, old workings.
57. Camborne Mining District.
58. South Huel Bassett and Buller.
59. Huel Kitty, Tin Bounds.

60. Huel Burrow and Butson, longitudinal section.
61. do. do. transverse do.
62. Illogan Estate.
63. Huel Liberty, transverse section.
64. Manor of Linsburne.
65. Huel Mithian, longitudinal section.
66. Tresavean, plan of part of.
67. Huel Lydia.
68. Huel Rose, section.
69. Gwinear, deep adit.
70. Huel Liberty, longitudinal section.
71. South Huel Towan.
72. Pednandrea, plan.
73. do. section.
74. Huel Lydia.
77. St. Agnes, Tin Bounds.
78. Pendarves and St. Aubyn, Consols.
79. Mining Sections, Camborne
80. Huel Liberty (Old).
81. South Huel Tincroft.
82. Manor of Mithian.
83. Consolidated Mines.
84. Huel Mithian, transverse section.
85. Birch Tor.
86. Tregorden Mine sett.
87. do. do. working plan.
88. do. do. section.
89. Huel Buller, old workings.
90. United Mines, North and South Lode.
91. Pennance Mine, plan.
92. Dolcoath Mine, cross section.
93. do. caunter lode.
94. do. plan of levels.
95. do. surface plans, &c.
96. do. bearing of lodes.
97. Cook's Kitchen, plan.
98. do. Chapple's Lode.
99. Tremearne Cliff.
100. Huel Pever, section.
101. do. transverse section.
102. do. vertical do.
103. do. George's Shaft.
104. do. Nichol's Shaft.
105. do. Davey's Shaft.
106. Copper Hill, plan.
107. Arkendale, Yorkshire, section.
108. Penzance and Hayle, lodes near.
109. Huel Liberty, longitudinal section.
110. Huel Prudence, elevations at.
111. Porthalla, veins at.
112. Mopus, elvans at.
113. Perran mining district.
114. Huel Virgin, stream work.
115. Derwent Mines, section of.
116. Old Huel Pever.
117. Trewavas Head, veins.
118. Granite joints, Scilly.
119. do. do.
120. West Huel, Darlington.
121. Sections across Cornwall.
122. Boase's Geological Map of Cornwall.
123. Tincroft, plan.
124. Clyjah and Wentworth.

Appendix C.

PLANS OBTAINED FOR MINING RECORD OFFICE.

125. Huel Buller, recent workings.
126. Huel Bassett, do.
127. Huel Wrey, plan.
128. Ludcote, do.
129. North Huel Trelawney, plan.
130. South Caradon, underground workings.
131. Tincroft Consols.
132. Lanivet Consols.
133. Tretoil Mine.
134. Huel Rose and Hernon, surface plan.
135. Huel Kekewick Mine.
136. South Huel Rose, plan.
137. Trebell Consols.
138. Huel Emily, plan.
139. Penvivian Tin Mine.
140. Tretoil Mine.
141. Huel Sarah, plan of set.
142. Treluswell Iron Mine.
143. District between Geneva and St. Jean de Mannenne.
144. Map of Ruhr District of Germany.
145. Candonga Mine, section.
146. do. do.

In addition to the above, numerous reports, prospectuses, and statistical documents have been added to the collection.

ROBERT HUNT, Keeper of Mining Records.

January 3, 1857.

III.

DONATIONS to the MUSEUM of PRACTICAL GEOLOGY, during the Year ending 31st December, 1856.

ARKINSTALL, Mr., Bromford Iron Works (Messrs. Dawe's), near Birmingham.—A remarkably fine crystallized slag, consisting of silicate of protoxide of iron, or Iron Olivine.

SMITH, Mr. T. MACDOUGALL.—A specimen of coal, shewing the interstratification of two varieties, from the Iron Colliery near Wrexham.

FRANKLIN, Lady (through Mr. Majendie).—Three specimens of white topaz, illustrating the crystalline form, the cleavage, and cutting for purposes of jewellery.

MAJENDIE, Mr. ASHURST.—A crystal of quartz, containing liquid in a cavity of polygonal form, from the Tintagel Slate Quarries, Cornwall, and various other minerals.

HYDE, Mr. BURROWS.—A specimen of Franklinite from Sarrel County, State of New Jersey, United States; also a peculiar carbonaceous material found in considerable quantity in the same State.

WESTWOOD, Mrs. J. O.—A specimen of ancient pottery, found under the foundation of an old house in Fleet Street, 1825.

GOSSE, Mr.—A specimen of yellow sulphate of baryta with quartz, from Nutfield, Surrey.

WALKER, Mr. R.—Three specimens of early English porcelain.

MORTON, Professor.—A specimen of flexible sandstone.

WALL, Mr. G. P.—A specimen of arsenical silver blende from Johanngeorgenstadt in Sachsen.

BLANFORD, Mr. W. T.—A Burmese idol cast in lead.

WESTON, Mr. SAMUEL.—A specimen of sulphate of baryta, from Derry-ginah, Ireland.

PEARSALL, Mr.—A series of specimens illustrating the mode of occurrence and manufacture of salt, from Nantwich.

LABOUCHERE, Mr. Secretary.—Two carved filtering stones, made of siliceous grit, from Van Diemen's Land.

TYLOR, Mr. ALFRED.—Specimens illustrative of Biddell's patented process for tooth cutting wheels.

LEE, Dr. JOHN.—Nine glass prisms, made in 1856 from sand existing on the Hartwell estate, near Aylesbury.

BARLOW, Dr. H. C.—A specimen of the deposition from water, obtained from the remains of an old Roman aqueduct in the vicinity of Arles, South of France.

DOLBY, ERNEST, Mr.—A specimen of veinstone from the mine Churprinz Friederick August, near Frieberg, Saxony.

PERCY, Mr. EDMUND.—A very fine specimen of brown earthenware, manufactured at Nottingham, having inscribed upon it "Made at Nottingham y^e^ 17^th^ day of August 1771."

REAY, Mr. W.—Various minerals from Cocaes Mine, &c., Brazil, South America.

MACDONALD, Major.—Various additional specimens to a collection previously presented in illustration of the mode of occurrence of the turquoise.

BEAUFORT, K.C.B., Rear Admiral Sir Francis.—A crystal of beryl.

LOFTUS, W. K. Mr.—A portion of a carved slab of alabaster from Assyria, also two ancient copper knives from Tel Sifr.

MYERS, Messrs. A. and S. JOSEPH.—Illustrations of the useful arts.

No. 1. Manufacture of a needle.

No. 2. Manufacture of a pin.

COLLINS, Mr. J. B.—A lamp fished up from the deep channel between the Islands of Gozo and Cumino (dependencies of Malta) in the year 1837; also various mineral specimens from Gozo.

NEWALL and Co., Messrs. R. S.—A model of a flat rope pulley with wrought iron arms mounted on pit frame.

FFARINGTON, Miss.—A porcelain cup and saucer made at the Herculaneum Pottery, Liverpool, about the year 1820.

COCKS, Lt.-Col. CHARLES LYGON.—A collection of geological specimens brought from the Crimea.

SIMPSON, Mr. FRANCIS.—A six-inch cube of the Little Castleton freestone.

STUCHBURY, Mr. S.—Two fine specimens of stilbite from Yarringari-wuardi, near Mount Nombi, west side of Liverpool plains, New South Wales (a new locality).

TREBY, Mr. HENRY H.—A specimen of the porcelain formerly manufactured at Plymouth.

JONES, Mr. S. T.—A specimen of ochre from the ten feet seam, Anne Maria Mine, Barmouth, Merionethshire.

PENTLAND, Mr. W. B.—A terrestrial globe, coloured to illustrate M. Elie de Beaumont's theory of volcanoes.

BARBERI, The Cavaliere, Rome.—A valuable series of specimens illustrating the history and manufacture of Roman Mosaic.

LOWE, Mr. J.—Specimen of septaria from the Lower Oxford Clay, near Chippenham.

MACDONALD, Mr.—A cube of granite from Aberdeen, one face polished.

CLARENDON, K.G., The Earl of.—An earthenware vessel from Abbeokuta, West Africa, made from a clay in which scales of yellow mica are abundant and which were supposed to be gold.

DAWSON, Mr. ALFRED.—Specimens to illustrate his patented process of preparing fuel from small coal.

BLACKWELL, Mr. S. H.—A specimen of graphite and titanium from the bear of a blast-furnace at Bilston. The mass weighed about ten tons.

SUTTIE, Sir GEORGE GRANT.—A specimen of bitumen, and a piece of grit with the bitumen attached to it.

MACKWORTH, Mr. HERBERT.—His improved Miners Safety Lamp.

ARNOLD, Mr. A. U.—A specimen of tin in the form of a stalactite.

KENNEDY, The Right Hon. T. F.—Specimens of draining pipes, and of the clay in its raw and prepared state from which they are manufactured in Ayshire.

HENNELL, Mr. G. R.—Various specimens of precious stones in their rough and polished states.

CARRUTHERS, Mr.—A specimen of Worcester porcelain, manufactured by Chamberlin.

TRENHAM REEKS, Curator.

Appendix C.

DONATIONS TO THE SCIENTIFIC LIBRARY.

IV.

Donations to the Library.

WILSON, Dr. GEORGE.—Researches on Colour Blindness. 1 vol. 8vo. cloth 1855.

Electricity and the Electric Telegraph; to which is added the Chemistry of the Arts. 1 vol. 12mo. unbound. 1854.

ROYAL SOCIETY, The Council of the.—The volumes of the Transactions for the years 1851–52–53–54–55, inclusive.

FAIRBAIRN, Mr. WILLIAM.—Useful Information for Beginners; being a Series of Lectures delivered to the Working Engineers of Yorkshire and Lancashire. 1 vol. 8vo. cloth. 1856.

SPENCE, Mr. WILLIAM.—An Introduction to Entomology; or, the Elements of the Natural History of Insects. Seventh edition, with an Appendix. 1856.

MARCOU, Mr. JULES.—Carte Géologique des Etats Unis et de Provinces Anglaises de l'Amérique du Nord.

CARPENTER, Dr. W. B.—Researches on the Foraminefera. 4to. pamphlet.

ROEMER, Dr. FERDINAND.—Ueber Melonites. 8vo. boards.

TURIN, The Royal Academy of Sciences of.—Volume xv. of the Memoirs of the Society. 4to. 1855.

NORTHUMBERLAND, the Duke of.—Descriptive Catalogue of a Cabinet of Roman Family Coins, belonging to his Grace. By Rear Admiral W. H. Smyth 1 vol. 4to. cloth bound.

MARCOU, M. JULES.—Résumé explicatif d'une Carte Géologique des Etats-Unis et des provinces Anglaises de l'Amerique du Nord.

PRITCHARD, Mr. ANDREW.—A General History of Animalcules. Illustrated by 500 engraved drawings. 1851.

VIENNA, The Geological Institute of.—The Transactions for the Year, &c.

SHARPE, Mr. HENRY.—Das Flötzgebirge Würtembergs. Von Fr. Aug. Quenstedt. 1 vol. 8vo. Tübingen, 1843.

BAVARIAN GOVERNMENT.—Uebersicht der Produktion des Bergwerks. Hütten- und Salinen-Betriebes in dem bayerischen Staate für das Verwaltungsjahr. 1850–51, 1851–52, 1852–53–54, und 1854–55. (Through the Bavarian Minister.

SOCIETY OF ARTS, The Council of.—The Journal of the Society.

TRENHAM REEKS, Librarian.

V.

RETURN of MAPS and SECTIONS of the Geological Survey of England supplied for sale to Messrs. Longman & Co., the publishers.

	From 1st April to 31st Dec. 1856.	From 1st April 1855, to 31st Mar. 1856.
Whole sheets	460 copies.	325
Quarter sheets	1,538 „	773
Horizontal sections	238 „	180
Vertical sections	144 „	110
Index of signs and colours	42 „	11
	2,422	1399

One hundred and sixty copies of the New Quarter sheets of the Geological Survey of Ireland have been supplied to Messrs. Hodges & Smith, Dublin, for sale.

GEOLOGICAL SURVEY

Explanation.

The Plates in the Map colored thus are — Published — 1st 25th Feb.y 1856 / 2d 31st Dec.r 1856

D.o thus ..... Engraving

D.o thus ..... Surveying

D.o thus ..... About to be Surveyed

GEOLOGICAL SURVEY — Number of Plates Plates Published 49 3/4 ; D.o Counties Complete ___ 19 ; D.o ___ D.o ___ in Part ___ 17

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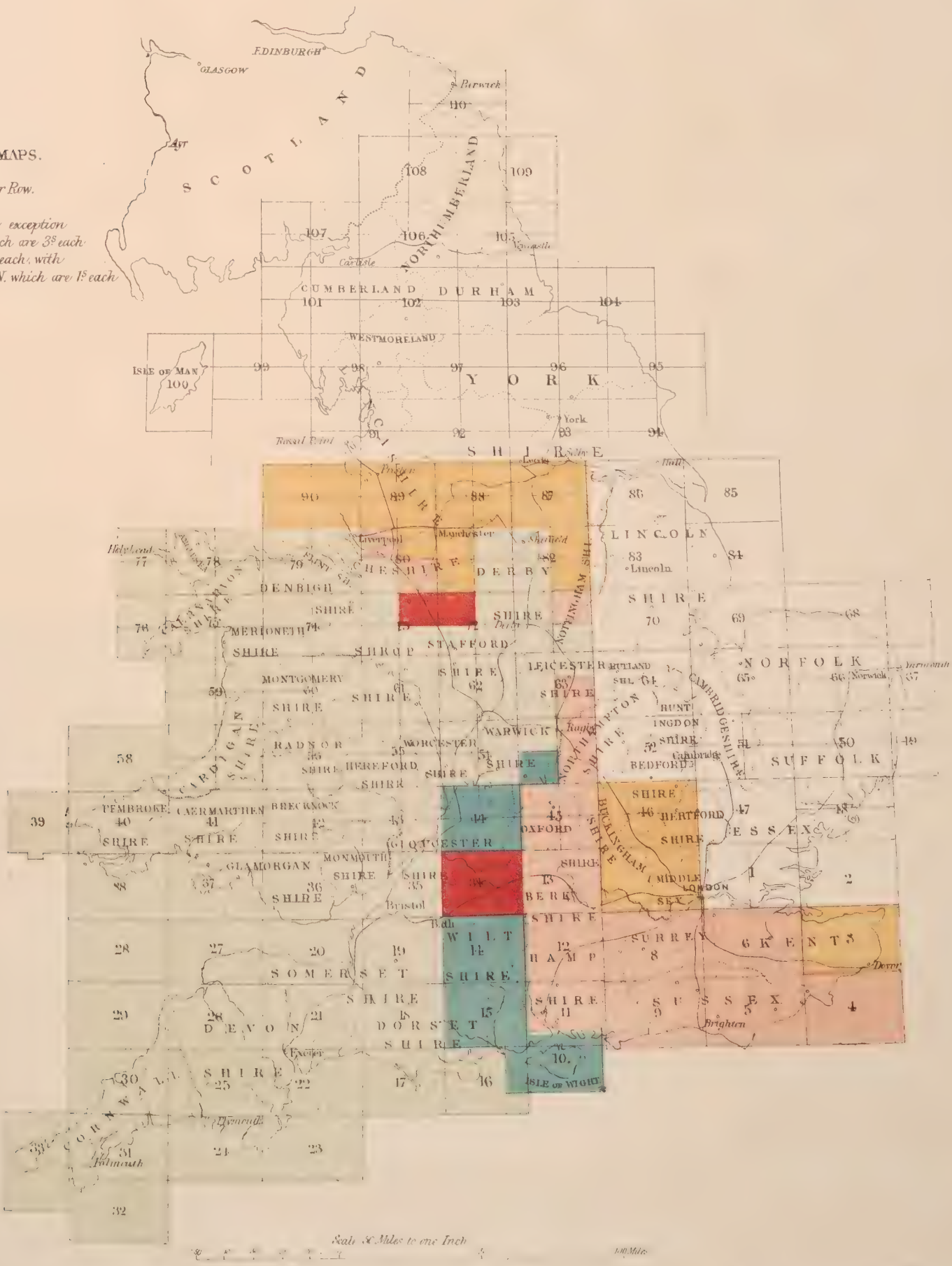
rice of the quarter-sheets is 2s 6d each with
xception of 57 N.W. 76 N. and 77 N. which are 1s each

INDEX MAP
(A)
to the
GEOLOGICAL SURVEY OF GREAT BRITAIN,
(ENGLAND AND WALES)

Published
in Sheets on a Scale of one Inch to a Mile
Shewing the Progress to
Dec.r 31st 1856.



Andw Ramsay
Local Director of the Geological
Survey of Great Britain
31st December 1856.

INDEX MAP
(B)
to the
GEOLOGICAL SURVEY,
OF GREAT BRITAIN
(SCOTLAND)

Shewing the Progress to
31st Decr 1856.

EXPLANATION

Surveying

° REFERENCE

The portions lettered A. B. C. D. E. F. G. H. *belong to* CROMARTY
" . . . . . B . . . . . ROSS
" . . . . . I . . . . . NAIRN

Scale — 32 Miles to One Inch.

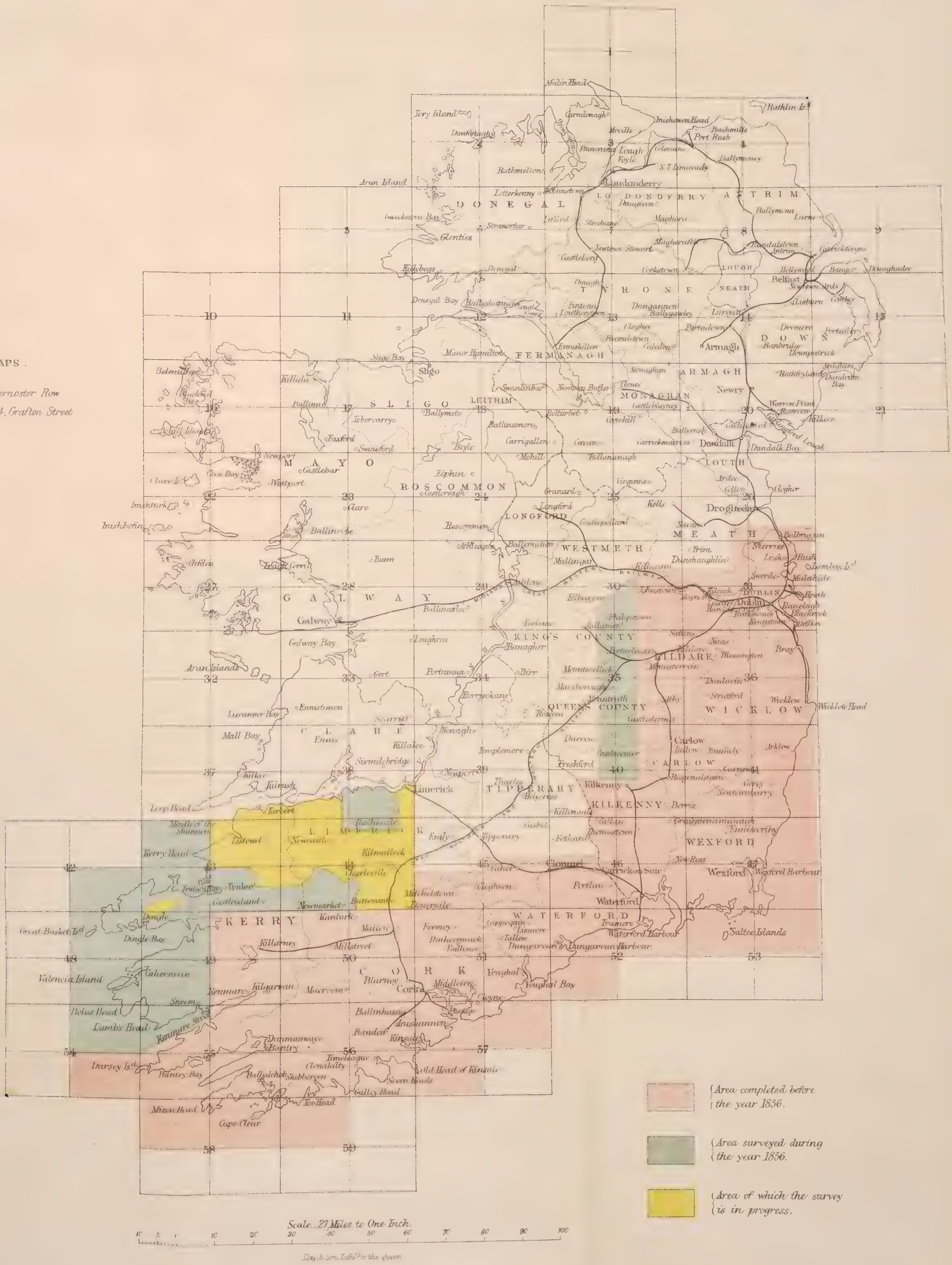
Day & Son, Lith.rs to the Queen.

Andw Ramsay
Local Director of the Geological
Survey of Great Britain
31st December 1856.

INDEX MAP
(C)
Shewing the state of the
GEOLOGICAL SURVEY
of
IRELAND
on the Six Inch Map on December 31st 1856.

AGENTS
for the
OF THE GEOLOGICAL MAPS.

Messrs Longman & Co *Paternoster Row*
Messrs Hodges & Smith, *104, Grafton Street*



Day & Son, Lith.rs to the Queen

Dec 31st 1856. J. Beete Jukes.
(Local Directo

INDEX MAP
(D)

Shewing the state of the

GEOLOGICAL SURVEY
of

IRELAND

As published on the ONE INCH Map
on Dec^r 31^st 1856.

Malin Head
Tory Island
Carndonagh
Inishowen Head
Dunfanaghy
Moville
Bushmills
Port Rush
Buncrana
Lough Foyle
Coleraine
Ballymoney
Rathmelton
N.T. Limavady
Aran Island
Londonderry
Letterkenny
St. Johnstown
LONDONDERRY
ANTRIM
DONEGAL
Dungiven
Ballymena
Gweebarra Bay
Lifford
Strabane
Maghera
Larne
Stranorlar
Glenties
Newtown Stewart
Ballycastle
Castlederg
Ballybofey
Donegal
Cookstown
LOUGH
Belfast
Omagh
TYRONE
Donegal Bay
Ballyshannon
Fintona
Dungannon
Ballygawley
Portadown
Armagh
DOWN
Sligo Bay
Manor Hamilton
FERMANAGH
Sligo
Monaghan
ARMAGH
Belmullet
Killala
Swanlinbar
Newtown Butler
Clones
Newry
MONAGHAN
Ballina
SLIGO
LEITRIM
Castleblayney
Tubercurry
Belturbet
Cootehill
Achill Island
CAVAN
Ballyjamesduff
Carlingford
Foxford
Carrigallen
Cavan
Carrickmacross
Dundalk
Swineford
Boyle
Mohill
Dundalk Bay
Newport
MAYO
Castlebar
Bellanamagh
LOUTH
Clare Is^d
Elphin
Ardee
Westport
ROSCOMMON
Castlerea
Virginia
Collon
Inishturk
Clare
Longford
Kells
Drogheda
LONGFORD
Inishbofin
Ballinrobe
Castlepollard
Navan
MEATH
Roscommon
Balbriggan
Athlone
Ballymahon
WESTMEATH
Trim
Tuam
Mullingar
Dunshaughlin
Skerries
Lusk
Clifden
Killucan
Swords
Malahide
Corrib
GALWAY
Johnstown
Maynooth
DUBLIN
Howth
Killeigan
Dublin
Ballinasloe
Galway
Philipstown
Tullamore
Kingscourt
Blackrock
Dalkey
Galway Bay
Loughrea
KING'S COUNTY
Banagher
Naas
Sallins
Kildare
Bray
Portarlington
KILDARE
Blessington
Monasterevin
Gort
Portumna
Birr
Mountmellick
Dunlavin
Borrisokane
Maryborough
Stratford
Ennistimon
Mountrath
Athy
Wicklow
Wicklow Head
QUEENS COUNTY
Scarriff
Castledermot
WICKLOW
Mall Bay
CLARE
Ennis
Nenagh
Carlow
Darrow
Killaloe
Templemore
Tullow
Tinahely
Arklow
Castlecomer
Sixmilebridge
Irishford
CARLOW
Kilkee
Newport
Baganalstown
Carnew
Kilrush
Limerick
Thurles
TIPPERARY
Kilkenny
Gorey
Holycross
Newtownbarry
Loop Head
Tarbert
KILKENNY
Killenaule
Callan
Graiguenamanagh
Mouth of the Shannon
Rathkeale
Cashel
Enniscorthy
Tipperary
Thomastown
Tashwood
Newcastle
LIMERICK
Emly
Fethard
WEXFORD
Kerry Head
Hilmalleock
New Ross
Clonmel
Carrick on Suir
Tralee
Listowel
Castlegregory
Castlemaine
Milltown
Ballyheige
Ardfert
Abbeyfeale
Charleville
Mitchelstown
Doneraile
Waterford
Portlaw
Wexford
Wexford Harbour
Tralee Bay
Castlemaine Harbour
Ballybunion
Newmarket
Rathcormack
Ballyvee
Dungarvan
Dungarvan Harbour
Ballyheige Bay
Tarbert
Kilrush
Kilbaha
Kilcredaun Head
Scattery Island
Kilbaha Bay

Report of the Art Superintendent on the Nature of the Art Instruction afforded by the Department, and on the Means adopted for testing the Result of such Instruction, both as regards the more Advanced Studies and those wholly of an Elementary Character.

Appendix C. Report on Nature of Art Instruction.

My Lord, South Kensington, December 31, 1856.

Very soon after the formation of the Department of Art, it became evident that the previous efforts to give instruction to artizans in ornamental art, with a view to improving the taste of our national manufactures, had been unproductive of results from the want of a wider diffusion of precise instruction in elementary drawing to all classes of the public.

The first efforts of the new Department were, therefore, directed to the diffusion of elementary instruction in drawing, and to providing for its forming a part of general education.

The means adopted were as follows:—

1. By extending the teaching of the schools of art to as many as possible of the schools for general education in their vicinity, and more especially to those for the poorer classes; and by devising a means of carefully and equally testing the progress made in sound elementary drawing, both in London and in the provinces.

2. By devising means, in concert with the Committee of Council for Education, for giving a systematic course of instruction in drawing to students in training colleges, and to apprentices and pupil-teachers, and schoolmasters and schoolmistresses generally; as well as for a searching examination, on which to grant them certificates of competency.

3. By the change of the former schools of design into schools for art-instruction; by largely increasing their number in the provincial towns and in London; regulating the precise course of instruction in them; and requiring specified works to be sent up to the Department every six months for examination and reward.

4. By the formation of a normal school for training qualified art-teachers; testing their qualifications by carefully-devised examinations; and granting them certificates on the results of the examinations.

1. Primary Instruction.

The means adopted to spread instruction in elementary drawing among the whole population were to require the masters in each provincial school of art to teach drawing in three, and subsequently in five, parochial schools, and to admit pupil-teachers and school masters and mistresses at low fees to qualify themselves for teaching drawing as a part of general education in their schools. Added to this, an examination of these pupil-teachers and schoolmasters, and of students in training schools under the Committee of Council for Education, was undertaken

Appendix C.

Report on Nature of Art Instruction.

by the Department, in order that their qualifications for this duty might be properly tested and certified.

By these means, the appreciation of drawing as a part of primary education is now greatly extended. Its value as a means of strengthening the perceptive powers, inducing order, precision, neatness, and system, besides giving facility to the hand in writing, mapping, &c., as well as its obvious utility in aiding the student to comprehend the teacher's illustration of the lessons, begins to be clearly felt and understood, as well as its use as an improving amusement for leisure hours. By means of the masters of art-schools, and also by means of the school-teachers thus trained and certified, a large and increasing number of youths are receiving sound instruction in elementary drawing.

The Department, ever recognizing it as the soundest policy to stimulate the public to do its own work of instruction rather than to leave it to be carried on by the central Government, has this year made an experiment towards a general examination of the *first grade*, to test thereby the results of this wide-spread elementary teaching, and to stimulate its further progress by adequate inducements to the public to seek it, and to the teachers to qualify themselves to give it.

With this view, a general examination of the FIRST GRADE has been held in a limited number of towns whose characteristics were thought to be so varied as to afford an insight into the working of a system throughout the country, whereby small rewards of instruments and materials for drawing should be granted to all scholars who are successful in completing the papers, and money-payments to the masters and teachers in whose schools these successful competitors have been taught.

As introductory to these extended examinations, I have myself been present to conduct them in Norwich, and in Liverpool, and Caernarvon, in conjunction with the Inspector General. In each of which places central schools of art are established.

The difficulty, however, was to make the nature of these examinations widely known and understood, so that on these first occasions the numbers coming up for examination were necessarily small.

In Liverpool 592, examination papers of the first grade were attempted, in Norwich 179, in Caernarvon 73; and of these numbers 271 were successful in Liverpool, 67 in Norwich, and 22 in Caernarvon (including Bangor). In the summer of this year, the Governors of Christ's Hospital requested me to undertake an examination of the boys who are taught drawing in that establishment, and in order to initiate the system, an examination of the first grade was, on this occasion, adopted. These youths are of a higher and much more educated class, and have generally been much longer under instruction in drawing than those examined in the above-named places; and as the teacher at Christ's Hospital has not been trained or certified by the Department, the numbers entering and succeeding in that great public school would afford some scale whereby to judge of the instruction in drawing afforded to the middle classes. The number of papers attempted

by the pupils at Christ's Hospital was 80; the number of successful competitors, 50. Thus in Caernarvon 30 per cent. were successful; in Norwich 37 per cent.; in Liverpool, 46 per cent.; at Christ's Hospital, 62½ per cent.

The further results of the examinations of the first grade will be seen in the reports of the Inspectors (*vide* page 183).

These first-grade examinations are intended to include drawing from copies, drawing from models and objects, and drawing from memory; but in the above instances, the majority of examination papers attempted consisted of the first "drawing from copies."

The result of these examinations has shown that a great impulse and stimulus to drawing has been given in those towns to which they were extended, and that in future years the applicants would be greatly more numerous.

The action of the Department from its first foundation has been to render instruction, as far as possible, self-supporting; but there can be no doubt that it is necessary in some manner to assist our own masters and the masters of schools generally in their efforts to spread a knowledge of elementary drawing among the poorest classes, where it is either wholly unpaid for, or only assisted by uncertain and eleemosynary contributions; and it would seem impossible to contribute in any sounder manner, or by any more legitimate means, than by the State thus making a small allowance, when it has by its own officers tested that the work has been soundly and legitimately carried out.

I would therefore strongly urge the gradual adoption of the principle of paying for the results of teaching throughout the country. The expense would be comparatively small, and always under immediate control, since the papers can from time to time be increased in difficulty; as the knowledge of art becomes more general, the need for a stimulus to its acquisition is removed, or the amount of the State's contribution in aid is too largely called upon.

Examination of Pupil-Teachers and School-Masters and Mistresses.

In concert with the Committee of Council on Education, arrangements have been completed for an annual examination of all pupil-teachers and students in training-colleges and institutions, by means of five timed papers, namely, freehand drawing, linear geometry, linear perspective, model-drawing, and memory-drawing; while an annual examination is also held at the training-school of the Department for those school-teachers who are *not* under inspection or certified by the Committee of Council.

Success in one or more of these papers is registered in favour of the examinants towards a full certificate of competency to teach drawing as a part of the general instruction afforded in their schools. It is, however, in contemplation to merge these examinations in those of the *second grade*, which will be spoken of in the next section of this report. The results for the past year will appear in the reports of the Inspectors.

Appendix C.

REPORT ON NATURE OF ART INSTRUCTION.

ART SCHOOLS.

The increased numbers of art-schools, and the largely increased attendance of pupils, will also be seen in the Inspector's reports. It has hitherto been my duty, both as Art Superintendent and also in conjunction with Sir C. Eastlake and Mr. Maclise, to examine the works transmitted from the schools of art, to award medals to the most deserving, and to report on the general progress in art-instruction which they evidence: but the great increase of schools in connexion with the Department, and the corresponding increase of works, had, in itself, rendered some change imperative, and this year it was found necessary to discontinue the practice of forwarding works from the various schools, and to have annually an inspecting examination in each separate town.

This change was called for on various other grounds:—1. Only a small portion of the works produced in each school, those, namely, which were forwarded according to regulation, were examined; 2. In those stages of the school course which include the science of form, such as geometry, perspective, orthographic projection, &c., the drawings sent up, often mere copies, without having been worked step by step from an acquaintance with the principles, were no real test of the knowledge of the pupils. It was thought best, therefore, to provide for a local inspection of *all* the works of each school; for the award of medals in certain stages; and for an examination by means of papers, whereby the real knowledge of the students should be accurately and equally tested in geometry, perspective, orthographic projection, and model drawing: prizes of drawing instruments, books, and other materials, being awarded to all who successfully complete the required papers.

Moreover, as the real aim of the Department is to spread the knowledge and practice of art by all possible means, these examinations of the second grade were extended to include all persons in the district who come forward to attempt the required papers, the Department thus proposing to test and reward the results of successful teaching from any and every source, and to encourage local teachers to qualify themselves more thoroughly for their duties by the stimulus these public examinations hold out.

The general success of this extension of examinations of the SECOND GRADE will be seen in the reports of the Inspectors. In three provincial towns in which I assisted in the experimental examinations, namely, in Liverpool, Norwich, and Caernarvon, the results of the second-grade examination were as follows:—

Liverpool	147 papers attempted.	54	successful.
Norwich	48 „	19	„
Caernarvon, including Bangor	16 „	2	„

It must be remembered that no previous preparations had been made for these public examinations, that the intention to hold them was only very partially made known, and that on this first occasion it was chiefly those already in some way connected with

the instruction afforded by the school of art who came forward for for examination. There is no doubt but that on future occasions a much larger number would compete, and of them, probably, a larger per-centage be unsuccessful.

Appendix C.

Report on Nature of Art Instruction.

All the works from each district rewarded with local medals, and which, therefore, represent the most advanced teaching of the Art-schools, will in future be assembled together in some one of the large provincial towns, or in the metropolis. They will there be examined in competition, and a fixed number of *national* medals be awarded to the most deserving. The first examination of this nature will take place at Manchester in the spring of 1857, and it is hoped that Sir Charles Eastlake and Mr. Maclise will again join with me in awarding the medals.

The Training School.

The progress of the training-school, as tested by the two annual examinations of the masters in training, will be seen in the Appendix, page 59; it is sufficient for me to remark that the first demand for masters for the provincial schools having been supplied, students are enabled to remain longer in the training-school in order to their obtaining the higher certificates of the Department—certificates requiring proportionately a much longer course of study in each instance than those for the first group, on obtaining which it was formerly necessary, from the great pressure for masters, to place the holders in charge of schools.

By arrangements lately made with that view, those masters formerly so appointed to the charge of schools are enabled to return for stated periods into the training-class to seek for increased competence for their duties and higher certificates, their place being supplied for a limited time for that purpose.

Since it is manifestly desirable that persons appointed as art-teachers in schools should have a fair share of general education, every candidate for admission to the training class has this year, for the first time, been required to pass an examination previously in reading, writing, arithmetic, and history.

The result of this examination will be seen in the report on this subject (page 202). It is hoped by the continuance of the practice, increasing from time to time the proficiency required, a class of educated art-teachers will be formed, fitted in a still higher degree for their duties as instructors, and for the public position to which their duties will call them.

It has already been remarked, that the first urgent demand for teachers has been partly supplied, and that students are enabled to remain longer under instruction. The public also are becoming awakened to the importance of art as a part of public education, to the necessity for a carefully-considered course of study, and to the advantage of a rigid and well-defined system of public examination. It is evident, therefore, that the time has arrived when the examinations of the THIRD GRADE should be extended and perfected, and that those subjects which have hitherto been postponed to the more elementary ones should be defined and encouraged.

This is necessary in order to induce the students in our own training classes to qualify themselves in a still higher degree as public instructors. Moreover the want of public examinations open to all begins to be largely felt; both as an honourable register of individual success in study and a certificate of ability, and as a means of enabling schools, colleges, and other public institutions to ascertain the qualifications of candidates for admission to study or offices or employments in which an extended knowledge of art is required.

The present arrangements for examinations in this *third grade* have proved satisfactory, so far as the first five groups are concerned. But, in the view of prospective advance and the demands of the public, a high class examination and certificate for Architecture, and a high class examination and certificate for Ornamental art, should be defined.

The candidate for an architectural certificate should be required to have previously prepared himself in those mathematical studies which are the necessary preliminary qualifications. He ought previously to have obtained the certificates of the Department for groups 1, 2, and 3, modified in the case of the two latter groups as to oil-painting, which is not specially necessary to the architect. He should also have taken the certificate for mechanical drawing and orthographic projection (group 6), since a perfect power of projecting all forms, and of drawing with facility both ornament and the figure, are necessary to his professional accomplishment.

He should have attended the class-lectures on ornament, and the lectures on the history and principles of architecture and architectural styles.

He should be required from written descriptions and measurements to design and to prepare, plans, elevations, sections, and perspective drawings of some large building, to make working and constructive drawings of any parts proposed for that purpose, as roofs, staircases, &c., and to prepare a detailed specification of works, and an estimate according to a schedule of prices.

It would be desirable also to require him to take a certificate for "Practical Mechanics" in the schools for science.

Candidates for the ornamental certificate should have previously obtained the certificates of the Department for groups 1, 2, and 3, or 1, 3, and 4. They should send in an ornamental design for some object, or some article of utility, and a monograph of some one historic style of ornamental art, accompanied by sketches of its elementary details. They should be required to design within a given time some specified work, and to prepare a careful model and drawing on a large scale. They should attend class-lectures on the history, principles, and elements of ornament, and on the history and principles of architecture, and be examined by papers on these subjects.

It is to be hoped that, with the addition of these examinations and works, the certificates of the third grade would be rendered tolerably complete, and easily so grouped as to be suitable for any school or public institution requiring a testing examination in drawing.

Considering the labour required to obtain the architectural certificate, it should have a *maximum* money value (subject to the usual conditions) of 30*l.*, and it would also be desirable that the holder of one of these certificates should be paid on the other necessary certificates to the full amount, and not confined to the total sum of 50*l.* The ornamental certificate also should carry a *maximum* value of 30*l.*

It would be desirable, however, in the preliminary progress towards these certificates, to provide for a 10*l.* certificate for architectural drawing only, to merge in the higher certificate, when obtained.

In view of these alterations, it would be necessary to increase the duties and emoluments of the class lecturer on ornament, and to provide for architectural lectures and teaching of a high class, which have been in abeyance since the resignation of Professor Semper.

The course of instruction being now precisely defined, and efficient means provided by prizes and medals to stimulate the public to require it ; and examinations

of the FIRST GRADE for primary instruction,
of the SECOND GRADE for advanced instruction,
and of the THIRD GRADE for qualified art-teachers,

having been prepared to test accurately the progress and results of the system, the future duty of the Department will be to carry out your Lordship's instructions by making every effort to induce the whole public, in every locality, to avail themelves of these advantages.

I have the honour to be, &c.
RICHD. REDGRAVE,
Art-Superintendent.

The Right Hon. Lord Stanley of Alderley,
&c. &c.

Report of Mr. Burchett, the Head Master of the Training School of Art.

Training School, Department of Science and Art,
29th January 1857.

Sir,

My Report of last year stated that the special classes had been at that time made a part of the Training School, and that from the commencement of the winter session of 1855 and 1856 the school would be only a Normal Training School; its instruction is now especially directed to the training of teachers, but the public is allowed to partake of the benefits of the instruction given on payment of fees.

The present Report is the first that includes the whole of the instruction given to the teachers employed, and the space occupied by the schools and classes at Marlborough House; I have felt it necessary to mention this to account for differences which will be perceived between this and the last report.

The results of the changes made immediately previous to October 1855 have been to increase the efficiency of the Training School, and to extend the qualifications included in the first certificate by the important addition of elementary architectural drawing, that certificate being now made to include, besides the general elementary art power, all those kinds of drawing which are directly useful to the working classes, which have hitherto been an unsupplied want in the schools.

The general progress of the Training School has been satisfactory, while its *district practising schools* have increased in their attractiveness and usefulness, as shown by the increased numbers attending them during the last half of the present year; the *parochial practising schools* have improved and extended their influence in a still greater degree. The details of both these divisions of the school will be given under their respective heads.

The total number of male students in training during the period from 1st October 1855, to 31st July 1856, was 89; female students, 17; total, 106. Of these 33 were free students; 6 received an allowance of 5*s*.; 12 of 10*s*.; 10 of 15*s*.; 32 of 20*s*.; and 17 of 30*s*. a week each.

These numbers do not agree with the total, as students pass from one list to another during the year, and therefore, in some cases are counted twice; once, for example, in the 5*s*., and once in the 10*s*. list.

Five masters appointed to provincial schools have returned for a short period to the training school to study for another certificate, with a view of returning to the same provincial schools. Two masters have re-entered the training school on an exchange of schools. One master has returned to the training school on account of the school of which he had charge being discontinued.

Appendix C.

HEAD MASTER'S REPORT ON CENTRAL SCHOOL OF ART.

The advantage of retaining students longer in the training school has been shown during the present year by the certificates taken,

22	having	been	taken	for Group 1st
7	„	„	„	2nd
2	„	„	„	4th
6	„	„	„	6th

1 student has remained 6 sessions in the training school.

7	„	„	5	„	„	„
14	„	„	4	„	„	„
17	„	„	3	„	„	„
25	„	„	2	„	„	„
16	„	„	1	„	„	„
9	„	„	less than one session.			

Twenty-one students have been appointed to masterships ; four have retired from the school ; and three have been dismissed.

Of the students admitted to the training school, the

Metropolitan	schools	have supplied	24
Dublin	„	„	2
Warrington	„	„	1
Sheffield	„	„	1
Newcastle	„	„	1

and four persons previously unconnected with the schools have joined the training school.

The number admitted from the Metropolitan schools exceeds those from other schools, because the *free* admissions and smaller weekly allowances are rarely available to other than Metropolitan students, being in fact the equivalent of the prize-scholarships and pupil-teacherships of the provincial schools. The advantages secured by this early admission have been to render the attainment of the first certificates less costly to the Department, and to secure a younger body of advanced students, who from their youth may be retained longer at less cost in the training school. No injustice is done by this arrangement to provincial students, who are always admitted to the school whenever their works have come up to the requisite standard.

1 Metropolitan student has obtained the first certificate without any cost to the Department.

						£	£	s.
2	having received	5*s.*	a week	for	2 sessions each,	13	= 26	0
5	„ „	10*s.*	„	„	„	26	= 130	0
1	„ „	15*s.*	„	„	„		= 39	0
1	„ „	20*s.*	„	for	1 session		= 26	0
1	„ „	20*s.*	„	for	3 sessions		= 78	0
Total, 11 first certificates.					Total cost -		£299	0

Average cost of first certificate by Metropolitan students - - - - £27 3 8

			£	s.	
1	Provincial student has obtained the first certfiicate without cost to the Department,				
1	having received 15*s.* a week for 1 session		= 19	10	
4	„ „ 20*s.* „ for 2 sessions,	52	=208	0	
2	„ „ 20*s.* „ 3 „	78	=156	0	
Total, 8	first certificates.	Total cost -	£283	10	

Average cost of first certificate taken by provincial students - - - £35 8 9

Of persons previously unconnected with the schools—

			£	s.
1	has obtained the first certificate, having received 15*s.* a week for 2 sessions - -		= 39	0
2	„ 20*s.* „ 2 „ - -		=104	0
Total, 3	first certificates.	Total cost -	£143	0

Average cost of first certificates taken by persons previously unconnected - £47 13 4

Of the students appointed to masterships in provincial schools during the present year :—

8 entered the training school from the Metroplitan schools.
1 „ „ „ Sheffield „
1 „ „ „ Newcastle „
1 „ „ „ Manchester „
1 „ „ „ Belfast „
9 previously unconnected with art schools.

Twenty-one students, who have been appointed to masterships during the present year have obtained 20 certificates for the 1st Group ; 7 certificates for the 2nd ; 1 for the 4th ; and 7 for the 6th. A total of 35 certificates at a total cost, in allowance to the Department, of 1,800*l.*, making an average cost of 51*l.* 8*s.* 6*d.* for each certificate.

The district practising school at Islington has been improved during the past year. Its Committee has been re-organized, and is now actively engaged in placing the school on a satisfactory basis. By their efforts the school is now one of the most comfortable and prosperous of the district schools. The Westminster school has been placed in abeyance in consequence of the affairs of the Literary Institution with which it was connected having become involved ; I hope, however, that arrangements will shortly be made for reopening this school. The Camden Town school has been discontinued, owing to inadequate attendance, caused by its inconvenience and the neglect of its affairs by the local management. Another school has been originated in the neighbouring locality of Hampstead, which I trust will go far to supply its place. Tables showing the numbers attending the district schools, and the works produced in them, will be found in Tables A. and B.

Appendix C.

HEAD MASTER'S REPORT ON CENTRAL SCHOOL OF ART.

A new connexion has been formed during the present year between the parochial and the district schools, by given as prizes of the highest grade in the parochial schools a limited number of free admissions to the district schools; and a similar arrangement has been made with respect to free admissions to the Central School. Four free admissions having been given during the present year to students of the district schools, and 19 students in the district schools have received free admissions to the lectures and library of the Central School. I believe, as it is found that this plan operates advantageously for the training school, the connexion of the parochial teaching with the district schools is likely to produce a continuance of the study of drawing on the part of the most promising parochial students.

The parochial teaching has very largely increased during the present year, 8 schools having been added to those in which drawing was already taught by the students in training. The total number now is 39, or rather 41 (as in one case three schools, numbering 311 students, are taught together). The number in the last report was 33.

The total number of children taught, as stated in the previous year, was 1,730, while the number at present receiving instruction amounts to 3,346, being an increase of 1,616 during the year; and as but few of those taught drawing during the past year remain in the schools, and many others who have been taught drawing during the present year have also quitted them, it is fair to say, that besides the number at present taught, from 1,500 to 2,000 have left the schools who have all received a greater or less amount of instruction.

Another satisfactory feature in the parochial teaching of the past year has been that instruction in drawing was introduced into 12 schools by the ordinary masters and pupil-teachers of the schools during the past year; there are now 28 teachers of this kind, and the children taught by them are 1,000 in number. The permanent masters are likely to feel a greater interest in the teaching of drawing, when instruction is given by themselves, and this circumstance is important, as being the first step in the introduction of drawing by the ordinary teachers of those schools.

The prizes distributed at the close of the previous year have been found to produce a good effect in stimulating the efforts of the students of the last year. The drawings sent in competition for prizes are this year of superior merit to those of last year 201 prizes have been awarded, besides 18 free admissions to district schools. Viewed as a whole, the parochial teaching for the past year presents an exceedingly satisfactory aspect. I am happy to say that these improvements have continued, a considerable further increase having taken place since October; but this time is not within the province of the present report.

The detailed Table of the Parochial Schools will be found in the Appendix at C.

I have thus endeavoured to place before you a complete statement of the progress of the school during the past year as a

training school; it now remains for me to state the results of the instruction which it affords to the public on the payment of fees. The number of students attending, and the amount of fees paid by them, will be found at Table D.

In addition to the sum of 728*l.* 18*s.* 6*d.* thus paid, 295*l.* have been received for parochial instruction, 25*l.* for the Whitelands Female Training School, and 32*l.* 10*s.* for that of schoolmasters, making a total of 1,080*l.* 18*s.* 6*d.* paid for instruction during the past year.

Having thus brought up my report to the closing of the school at Marlborough House in July, previous to its removal to South Kensington, I wish to place a comparative view of the accommodation of the schools before you. Table E exhibits the space devoted to class purposes at Marlborough House, and Table F. that at the new schools. The increase of 1,082 feet of space, however, but very inadequately represents the advantages derived by the removal. At Marlborough House the class-rooms were scattered through five distinct ranges of buildings, all unconnected with each other, rendering impossible any regular and complete system of supervision; by the removal, all the class-rooms are brought under one roof, and, for the male school, accessible by only one door. The rooms used in the houses at Kensington are also superior to those at Marlborough House in their light and ventilation; and although before the school can be placed upon a thoroughly satisfactory basis, other additions must be made. The translation of the training school has benefited its accommodation in many ways.

I cannot conclude my report, without expressing the great pleasure I have derived from the cordial and hearty co-operation of all my colleagues in the school, and my gratification at the results of their tuition.

At the close of the last year Mr. Walsh, the teacher of the figure, having retired from the school, Mr. Collinson, the master at Warrington, was appointed his successor, and has very efficiently performed the duties entrusted to him. Table G. contains the names and positions of the teachers in the schools.

I am, &c.
R. Burchett,
Head Master.

The Secretary of the
Department of Science and Art.

(A.)

METROPOLITAN DISTRICT SCHOOLS.

NUMBER of STUDENTS attending CLASSES.

Locality.	Classes.	First Session, 1855-56.					Second Session, 1856.				
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.	June	July.
Spitalfields chool, Crispin Street, Spitalfields .	General Course	93	83	87	80	93	97	90	84	83	79
	Schoolmasters' do.	31	31	31	31	31	17	84	17	17	17
Westminster School, Great Smith Street, Westminster.	General Course	37	31	27	27	29	33	*	—	—	—
St. Thomas', Charterhouse, Goswell Street . .	General Course	44	62	70	44	65	70	73	75	70	58
Camden Town School, High Street, Camden Town .	General Course	43	37	30	33	35	35	34	30	32	28
Finsbury School, William Street, Wilmington Square	General Course	58	58	58	44	54	59	59	52	50	47
Rotherhithe School, Grammar School, Deptford Road.	General Course	26	27	20	23	20	22	27	26	22	23
St. Martin's School, Castle Street, Long Acre . .	General Course	43	45	39	47	64	61	67	59	58	53
	Schoolmasters' do.	21	21	21	21	21	10	21	29	29	26
Kensington School, Gore House, Kensington . .	General Course	45	51	50	56	58	63	68	72	71	63
	Schoolmasters' do.	18	19	19	19	19	22	22	22	22	22
Lambeth School, St. Mary's, Prince's Road, Lambeth	General Course	14	12	11	29	29	29	22	24	24	15
	Schoolmasters' do.	4	8	8	8	8	8	8	8	8	8
		477	485	471	462	526	526	575	498	486	439

* Numbers in this School not obtainable from this date.

(B.)

NUMBER of WORKS EXECUTED in the DISTRICT SCHOOLS DURING the YEAR from 1st OCTOBER 1855 to 31st JULY 1856.

STAGES of INSTRUCTION.	Spitalfields.	Westminster.	Charterhouse.	Finsbury.	Camden Town.	Rotherhithe.	St. Martin's.	Kensington.	Lambeth.
1. Linear drawing by aid of instruments:									
a. Linear Geometry	96	24	60	38	—	41	—	7	3
b. Mechanical and machine drawing and details of architecture from copies	51	28	69	66	—	40	176	—	—
c. Linear Perspective	178	22	34	49	—	—	11	56	—
2. Free-hand outline drawing of rigid forms, from examples or copies:									
a. Objects	—	—	—	—	—	—	—	—	—
b. Ornament	626	129	604	292	140	104	294	396	158
3. Free-hand outline drawing from the "round:"									
a. Models and objects	94	—	6	5	—	—	12	48	29
b. Ornament	17	4	7	14	1	—	13	5	5
4. Shading from flat examples or from copies:									
a. Models and objects	—	—	—	—	—	—	—	—	—
b. Ornament	15	7	10	13	—	1	10	10	6
5. Shading from the round or solid forms:									
a. Models and objects	27	2	8	6	4	—	9	12	24
b. Ornaments	3	1	4	14	7	2	3	7	6
c. Time sketching and sketching from memory	—	—	—	—	—	—	—	—	—
6. Drawing the human figure and animal forms from copies:									
a. In outline	37	36	19	42	12	17	52	104	54
b. Shaded	—	—	—	—	—	—	—	—	—
7. Drawing flowers, foliage, and objects of natural history from flat examples or copies:									
a. In outline	—	—	—	—	—	—	—	26	—
b. Shaded	—	—	—	—	—	—	—	—	—
8. Drawing the human figure or animal forms from the round, or nature:									
a. In outline from casts	8	—	1	7	1	—	28	—	3
b. Shaded	11	—	—	6	6	—	8	—	4
10. Drawing flowers, foliage, landscape details, and objects of natural history from nature:									
a. In outline	8	2	3	6	—	3	—	10	—
b. Shaded	1	—	—	1	—	—	—	—	—
11. Painting ornament from the flat or copies:									
a. In monochrome, either in water colour, in tempera, or in oil	—	—	—	—	—	—	—	—	—
b. In colours	6	4	—	14	—	2	9	2	—
12. Painting ornament from the cast, &c.:									
a. In monochrome, either in water colours, in oil, or in tempera	1	—	—	6	—	—	—	—	1
13. Painting (general) from flat examples or copies, flowers, still-life, &c.:									
a. Flowers or natural objects, in water colours, in oil, or in tempera	4	—	1	11	—	1	1	1	—
16. Painting the human figure or animals in monochrome from casts:									
a. In oil or in tempera	2	—	—	2	—	—	—	—	—

(C.)

PAROCHIAL SCHOOLS taught from the TRAINING SCHOOL.

Schools.	Locality.	Lessons per week.	Payment per annum.	Period of Commencement.	Average Number attending.	No. of Prizes.	Remarks on the Drawings produced.
			£				
1. Birkbeck School	Willow Road, Peckham	2	10	May 24, 1853	180	10	Excellent.
2. Camden Town	Camden Street, Camden Town	1	5	May 26, 1853	149	6	Good.
3. Christ's Church	Albany Street, Regent Park	1	5	May 26, 1853	149	5	Good.
4. Trinity Schools	Hartland Road, Camden Town	1	5	May 26, 1853	148	6	Good.
5. St. James the Great	Bethnal Green Road	1	5	June 15, 1853	18	—	——
6. St. Stephen's School	Rochester Row, Westminster	2	10	July 26, 1853	52	6	Excellent.
7. Girls' School	58, Wells Street, Oxford Street	2	10	July 26, 1853	15	4	Excellent.
8. St. Mary's School	Hyde Place, Vincent Square, Westminster	2	10	Aug. 16, 1853	188	3	Good.
9. Coborn School	Fairfield Road, Bow, Middlesex	1	5	Aug. 17, 1853	204	7	Good.
10. St. Martin's, Boys' School	Castle Street, Long Acre	2	10	Aug. 25, 1853	88	8	Excellent.
11. St. Martin's, Girls' School	Castle Street, Long Acre	2	10	Aug. 25, 1853	30	2	——
12. Upper Chelsea, Trinity Church	Sloane Street, Chelsea	1	5	Sept. 29, 1853	42	6	Good.
13. St. James's	Marshall Street, Golden Square	2	10	Oct. 4, 1853	43	9	Excellent.
14. St. James's Offertory	Swallow Street, St. James's	1	15	Oct. 28, 1853	43	3	Fair.
15. Rotherhithe Church	Rotherhithe, Surrey	3	15	Oct. 29, 1853	125	16	Excellent.
16. London Orphan Asylum (Boys' School).	Clapton, Hackney	2	10	Jan. 9, 1854	65	7	Excellent.
17. Marylebone	Trinity District, Buckingham Street, Great Portland Street, Marylebone.	2	10	Jan. 24, 1854	59	2	Good.
18. Clapham Parochial	Clapham Common, Surrey	1	5	Feb. 9, 1854	203	7	Good.
19. Diocesan	Nutford Place, Edgeware Road	1	5	Feb. 28, 1854	45	3	Fair.
20. St. Andrew's	Holborn	1	5	Mar. 16, 1854	85	4	Good.
21. Charterhouse (Boys' School)	Aldersgate Street	2	10	——	112	7	Excellent.
22. Birkbeck	Southampton Buildings, Holborn	1	5	Sept. 1854	110	9	Excellent.
23. Birkbeck	High Street, near Railway, Kingsland	1	5	Sept. 1854	69	4	Fair.
24. Birkbeck	Finsbury	1	5	Sept. 1854	176	3	Good.
25. Birkbeck	Bethnal Green	1	5	Sept. 1854	75	7	Excellent.
26. Birkbeck	Vincent Square, Westminster	1	5	Oct. 24, 1854	77	6	Good.
27. St. Stephen's (Girls' School)	Rochester Row	2	10	July 26, 1853	64	12	Excellent.
28. London Orphan Asylum (Girls' School).	Clapton	1	5	April, 1855	25	4	Excellent.
29. Charterhouse (Girls' School)	Aldersgate Street	2	10	——	45	6	Excellent.
30. Jewish School	Red Lion Square	2	10	May, 1855	76	7	Good.
31. Camden Schools	Peckham	1	5	March, 1855	25	3	Fair.
32. St. Mary's	Wyndham Place, Bryanstone Square		5	Jan. 8, 1856	39	4	Good.
33. St. Sepulchre's	Greenhill's Rents, Smithfield		10	Jan. 11, 1856	136	2	Fair.
34. Portman	32, Dorset Street, Portman Square		5	Mar. 11, 1856	56	3	Good.
35. Brompton National	Bromptor Road		10	April 1, 1856	53	4	Good.
36. Marylebone	Buckingham Street, Portland Road	2	10	Feb. 1856	27	3	Good.
37. St. John's	Walham Green	1	5	May 16, 1856	45	2	Fair.
38. All Saints'	Islington	2	10	Sept. 1, 1856	180	3	Fair.
39. Hawkestone Hall	Waterloc Road	1	5	Sept. 24, 1856	25	—	Good.
				Totals -	3,346	203	

(D.)

Table of Classes, Hours, Fees, and Number of Attendances.

Hours of Assembling.		Hours of Departure.		Fees.		Number of Students who attend.			Total of Students.	Amount of Fees.		Total Amount.	Remarks.
Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Free.	—	Morning.	Evening.	—	—
				£	£					£ s. d.	£ s. d.	£ s. d.	
10	7	3*	9	4	2	51	78	76†	205	211 16 6	156 0 0	367 16 6	From October 1855, to February 1856.
.	.	.	.	.	.	65	60	75	200	239 2 0	120 0 0	361 2 0	From March to October 1856.
												£728 18 6	Total of Fees for the Two Sessions.

* Students are allowed to remain in the school until 4 o'clock, subject to the approval of the Master. The Library is open from 10 in the morning until 9 in the evening.

† Free Students include the masters in training, the scholars who receive an annual allowance, the junior training class, and those who are admitted without payment of fees.

Appendix C.

HEAD MASTER'S REPORT ON CENTRAL SCHOOL OF ART.

Class rooms.

(E.)

TABLE showing the AMOUNT of ACCOMMODATION and USES of the CLASS ROOMS at MARLBOROUGH HOUSE.

	—	Dimensions.	Accommodation of Students.	Total Area.
	MALE SCHOOL.	′ ″ ′ ″		
1	Elementary and General Class Room -	50 6 × 30 0	- -	6,208 feet.
2	Antique ditto -	30 9 × 25 0	- -	
3	Modelling ditto -	36 0 × 20 10	- -	
4	Class lecture room - -	36 0 × 20 10	- -	
5	Mechanical Drawing ditto -	24 6 × 24 0	- -	
6	Architectural ditto ditto -	15 5 × 14 5	- -	
7	Ditto ditto ditto -	16 10 × 14 6	- -	
8	Ditto ditto ditto -	18 10 × 15 10	- -	
9	Ornament ditto -	21 6 × 16 10	- -	
10	Porcelain Painting ditto -	23 3 × 19 6	- -	
11	Moulding and Casting ditto -	17 0 × 15 1	- -	
	FEMALE SCHOOL.			
1	Wood Engraving, Teachers' Room -	14 3 × 11 10	- -	2,268 feet.
2	Ditto Class Room - -	20 3 × 20 3	- -	
3	Ditto ditto - -	20 3 × 17 1	- -	
4	Lithography, Porcelain, and Ornament Class Room.	25 3 × 23 6	- -	
5	General Class Room for Mistresses in training.	36 0 × 20 10	- -	

(F.)

TABLE showing the AMOUNT of ACCOMMODATION and USES of the CLASS ROOMS at KENSINGTON GORE, SOUTH.

	—	Dimensions.	Accommodate Students.	Total Area.
	MALE SCHOOL.	′ ″ ′ ″		
1	Elementary and General Class Room -	56 3 × 30 3	- -	6,500 feet.
2	Antique ditto -	33 0 × 30 3	- -	
3	Modelling ditto -	36 0 × 20 9	- -	
4	Class lecture room ditto -	36 0 × 20 9	- -	
5	Painting ditto -	36 0 × 20 2	- -	
6	Architectural Drawing ditto -	27 11 × 15 7	- -	
7	Mechanical ditto ditto -	21 0 × 18 8	- -	
8	Ornament ditto -	18 6 × 18 3	- -	
9	Moulding and Casting ditto -	21 6 × 18 5	- -	
	FEMALE SCHOOL.			
1	Wood Engraving Class Room - -	61 0 × 19 8	- -	3,058 feet.
2	Antique ditto - -	22 3 × 18 2	- -	
3	Ornament ditto - -	23 0 × 18 0	- -	
4	Elementary ditto - -	27 3 × 18 8	- -	
5	Advanced ditto ditto - -	18 8 × 18 0	- -	
6	Painting ditto - -	15 1 × 15 3	- -	

(G.)

NAMES AND POSITIONS.

Names.	Positions.
Mr. R. Burchett - - -	Head Master.
Mr. R. W. Herman - - -	Deputy Head Master.
Mr. F. T. Collier - - -	Assistant Training Master.
Mr. W. Denby - - -	Teacher of Drawing and Painting.
Mr. R. Collinson - - -	Teacher of Figure Drawing and Painting.
Mr. C. Swinstead - - -	Teacher of Parochial School Inspector.
Mr. W. Binns - - - -	Teacher of Mechanical Drawing.
Mr. H. B. Hagreen - - -	Teacher of Architectural ditto.
Mr. J. Hancock - - -	Teacher of Modelling the Figure.
Mr. W. J. Wills - - -	Teacher of Modelling of Ornament.
Mr. J. Simpson - - -	Teacher of Porcelain Painting.
Mr. C. P. Slocombe - - -	Teacher of Ornamental Design.
Mr. D. Brucciani - - -	Teacher of Moulding and Casting.
Mr. J. Thompson - - -	Teacher of Wood Engraving.
Miss A. Waterhouse - - -	Ditto.
Miss Channon - - - -	Teacher of Lithography.

Appendix C.

REPORT ON FEMALE SCHOOL.

METROPOLITAN FEMALE SCHOOL.

Metropolitan Female School of Art,
37, Gower Street, 8th January 1857.

SIR,

I HAVE the honour to submit my Annual Report, and regret that I cannot refer to the success of the students in obtaining medals or rewards, as their works have not yet been required for competition. I feel confident, however, that when called for, they will show a continued improvement, and manifest the progress of the pupils generally, a result attributable to the efficiency and zeal of the teachers, to which I have the satisfaction of bearing testimony.

The attention, assiduity, and good conduct of the whole school have been exemplary.

I herewith enclose the usual tabular returns.

I have, &c.
FANNY M'IAN, Superintendent.

To the Secretary of the
Department of Science and Art.

TABULAR REPORT from the METROPOLITAN FEMALE SCHOOL, between 1st of October 1855 and the 1st of October 1856.

NAMES, &c. of TEACHERS.

Names.	Address.	Date of joining.	Fixed Salary.	Proportion of Fees.	Amount of Fees.	Total Income.
			£	£ s. d.	£ s. d.	£ s. d.
Fanny M'Ian	4, Heath Mount, Hampstead.	Sept. 1842	200	$\frac{3}{10}$ of 99 4 0 = 29 15 2 $\frac{2}{10}$ of 126 18 0 = 50 15 2	80 10 4	280 10 4
Louisa Gann	17, Brunswick Square.	April 1852	50	$\frac{3}{10}$	64 4 7	114 4 7
Catherine Wilson.	10, Grenville St.	Oct. 1855	50	$\frac{4}{10}$	42 16 4	92 16 4
Sarah A. Doidge.	6, Upper Albany Street.	Oct. 1854	None	Evening class	11 2 4	—
John Hancock.	Modelling master -	-	-	$\frac{10}{10}$	6 0 0	—

FEES.

The course of instruction is divided into two sessions, of five months each, from the 1st of October to 28th of February; and from the 1st of March to the 31st of July. The fees must be paid in advance for the whole of the session of five months.

	£	s.	d.
Elementary course - - - -	1	0	0
Advanced course - - - -	2	0	0
Exceptional course - - -	4	0	0
Modelling in clay or wax, &c. - -	2	0	0
Evening class - - - -	0	10	0

——	Hours of Assembling.	Hours of Departure.	——	On the Books.	Total.	Free.	Fees.	Total of each Session.	Yearly Total.	Yearly Total of Morning and Evening Classes.
	H. M.	H. M.	MORNING CLASSES.				£ s. d.	£ s. d.	£ s. d.	£ s. d.
Session from October 1855 to February 1856.	10.30	3.0	Exceptional - - -	- - -	88	10	- -	93 4 0		
	11.0	3.0	Advanced and elementary studies - - - -							
	11.30	12.30								
	1.0	2.30								
	11.0	2.0	Modelling - - - -	- -	- -	- -	- -	6 0 0		
									226 2 0	
Session from March 1856 to July 1856.	10.30	3.0	Exceptional - - -	- -	104	10	- -	120 18 0		240 0 0
	11.0	3.0	Advanced and elementary studies - - - -							
	11.30	12.30								
	1.0	2.30								
	11.0	2.0	Modelling - - - -	- -	- -	- -	- -	6 0 0		
			EVENING CLASS.						£ s. d.	
Session from October 1855 to February 1856.	6.0	8.0	Elementary - - -	- -	10	- -	5 4 0	5 4 0		
			Evening studies - -						13 18 0	
Session from March 1856 to July 1856.	6.0	8.0	Elementary - - -	- -	18	- -	- -	8 14 0		

Appendix C.

REPORT ON FEMALE SCHOOL.

Female School, Gower Street.

STUDENTS classed according to their AGES.

No.		Evening Class	
7	under fifteen years.	2	
53	above fifteen and under twenty.	6	
39	above twenty and under thirty.	14	
5	above thirty.	–	
104	Total.	22	Total of Morning and Evening Classes. 126

STUDENTS classed according to the PERIOD of their ATTENDANCE.

No.		Evening Class.	
43	attended less than one year.	14	
28	above one year, and under two.	7	
18	above two, and under three.	1	
11	above three, and under five.	–	
4	above five.	–	
104	Total.	22	Total of Morning and Evening Classes. 126

The Total number of individual students on the books from October 1855, to October 1856—Morning classes, 104; Evening class, 22. Total - 126

Total amount of fees received - - - - - £240 0*s.* 0*d.*

There are Four Free Students.

THERE are Four Pupil-Teachers appointed March 1854, and Two in October 1855.

Jane Todhunter.	Helena Wilson.
Charlotte James.	Rebecca Elliot.
Lucy Meadows.	Maria Edwards.

Lucy Meadows resigned her appointment, July 1856.

NUMBER of WORKS executed by the STUDENTS between October 1855 and October 1856.

			Morning Classes.		Evening Classes.
			October 1855 to March 1856.	March 1856 to October 1856.	October 1855 to October 1856.
Drawing Course.		Perspective and Geometrical	148	155	–
	Ornament -	Outlined from the flat - -	285	310	180
		Outlined from the round -	59	80	52
		Shaded from the flat - -	31	50	20
		Shaded from the round -	8	12	—
	The Figure	From the flat - - - -	12	20	—
		Outlined from the round -	33	43	—
		Shaded from the round -	29	59	—
		Anatomical drawings - -	4	7	—
		Flowers from Nature - -	13	17	—
		Botanical drawings - -	23	22	—
Painting Course.	Ornament -	In Monochrome from casts -	3	6	—
		In Monochrome from flat -	2	6	—
	Flowers and Fruit -	From the flat - - - -	37	54	—
		From Nature - - - -	8	11	—
		Compositions of colour - -	2	3	—
	The Figure	In Monochrome - - -	1	3	—
	Modelling -	Ornament - - - -	—	—	—
		The figure; from the feet -	3	—	—
		Elementary designs -	—	34	—
		Total - - - -	701	892	252

Documents relating to Administration of Museum of Art at Marlborough House.

1. Curator's Report.
2. Report of the Keeper of the Casts.
3. Table of Returns of Number of Visitors, &c.
4. Returns of Number of Visitors to Circulating Museum Collection in Provincial Towns.
5. List of Objects acquired by Purchase.
6. Catalogue of Loans.

I.

Report of the Curator of the Museum.

1st January 1857.

The acquisitions made to the Museum of Art during the past year, though less numerous than those of the preceding one, have not been unimportant. Many sections of the collection were so materially advanced by the purchases from the Bernal Collection as to render desirable a more specific choice in future acquisitions; and a comparison of the relative number of objects in the several sections added during the period to which the Report refers, will show that this object has been kept in view. Thus, specimens comprehended under the general heading, "Works in Metal," will be found to predominate; whilst, in the section of Pottery and Glass, categories in which the Museum had already made considerable progress, there have been but few additions. It should be observed, however, that, although a nearer approach to systematic action, in this respect, has become practicable, it does not follow that acquisitions can be made on any definite predetermined system; the occurrence of specimens for sale is so uncertain and irregular as to put such a plan entirely out of the question; and experience has shown that the safest rule is to acquire, with promptitude and decision, all really extraordinary works, even if they belong to classes in which the collection may be already comparatively rich.

As it is, the collection has advanced somewhat irregularly, but the inequality has resulted from other causes besides that of the mere fortuitous acquisition of specimens; thus the impossibility of locating bulky articles in the confined space at Marlborough House has visibly influenced the collection; the important section of furniture, or cabinet work, as a case in point, having for this reason been almost entirely neglected.

During the past year, as in previous ones, many highly important objects and of consequent costliness, presented for sale, have been declined for pecuniary reasons—a necessity much to be re-

Appendix C.

REPORT OF CURATOR OF MUSEUM OF ART.

gretted on account of the rapidly increasing scarcity of works, such as a national collection ought especially to possess. On this point I would observe, that a power of immediate decision as to the purchase of objects, the cost of which is considerable, has become even more necessary than with respect to those of less value, inasmuch as extraordinary specimens in every category are now sought for on all hands with an avidity, which renders price a secondary consideration. For this reason, the rule hitherto observed of depositing articles in the Museum, previous to purchase, is becoming, in most instances, impossible, because dealers being now able to count on the immediate sale of any important work to private collectors, no longer find it to their interest to remain in uncertainty as to the disposal of their property to the nation.

Appended is a list of loans to the Museum which have been limited only by want of space for their reception. Two important collections have been, during the year, exhibited at Marlborough House ; viz., that of G. Field, Esq., comprising upwards of 100 objects of great intrinsic and pecuniary value, and the Soulages collection numbering 750 specimens ; both were received on the usual footing under the established rules. The latter collection is still located at Marlborough House, and up to the date of this Report has been visited by 31,106 persons. The opportunity has also been taken to exhibit, for the first time in a collected form, the objects obtained from the Bernal sale.

Many reproductions of objects by means of the electrotype process, casting in plaster, and by photography, have been executed, as well of specimens belonging to the permanent collection as of those exhibited on loan, and all such reproductions are made available to the public at low prices.

It will be observed, that although the Museum has been open for a shorter period this year than in 1855, the number of visitors has been considerably greater, the relative number being as follows :—

1856. Open 210 days, number of visitors	- 111,768
1855. Open 231 days, number of visitors	- 78.427
Increase of visitors in 1856	- 33,341

The circulating museum collection has visited, during the past year, five localities, viz., Sheffield, York, Newcastle-on-Tyne, Carnarvon, N.W., Hanley (Potteries) ; the entire attendance at these places being 32,852. (*See* details in Table IV.) This system of circulating works of art may now be considered entirely successful, and I have to state, that the efficiency of the arrangements for transport has been evinced by the fact of not a single accident of any kind having as yet occurred, although many of the specimens are of the most fragile description.

The further issue of the Illustrated Descriptive Catalogue of the Museum has been discontinued since the re-opening of the Museum in November, and a Complete Finding Catalogue, or inventory of the entire collection prepared instead, the forthcoming removal and re-organization of the Museum at Kensington

having rendered the continuation of the former work, for a time, inexpedient. The "Inventory" will, however, from its nature, continue to be available notwithstanding any changes that may occur. In conclusion, I have to report that, preparations are making for the contribution of a numerous selection of specimens to the forthcoming "Art Treasures Exhibition at Manchester;" and it is expected that the experience already gained in the mobilisation of extensive sections of the collection, will enable this to be effected without any detriment to the precious objects, the perfect conservation of which is a paramount duty.

J. C. Robinson.

II.

Report of the Keeper of the Collection of Casts, at Marlborough House.

Want of room at Marlborough House has prevented any further systematic arrangement of the collection of casts. An attendant has, however, been employed to repair, paint, and preserve all the specimens, and I have to report that the collection generally is in a satisfactory state, as to condition. For the reason already given, no acquisitions have been made, although definite action in this respect is highly desirable.

I have further to state, that I have inspected all the casts supplied by the trade to provincial schools of art, and fulfilled all other current duties connected with the office of Keeper of the Casts.

J. C. Robinson.

III.

MUSEUM of ORNAMENTAL ART at MARLBOROUGH HOUSE, open 210 days, from January 1st to December 31st, 1856.—RETURN of VISITORS, &c.

Date.	No. of days in each month during which the Museum was open.	Visitors.				Receipts.								
		No. paid.	By cards.	Free.	Total.	Admission Fees.			For Sale of Catalogues.			Total Receipts.		
1856.						£	s.	d.	No.	£	s.	d.	£	s.	d.
January	27	337	83	8,840	9,260	8	8	6	193	2	2	9	10	11	3
February	25	358	121	7,830	8,309	8	19	0	157	3	18	6	12	17	6
March	26	277	91	19,250	19,618	6	18	6	97	2	8	6	9	7	0
April	26	450	161	8,990	9,601	11	5	0	153	3	16	6	15	1	6
May	27	496	109	15,650	16,255	12	8	0	172	4	6	0	16	14	0
June	25	442	136	7,680	8,258	11	1	0	145	3	12	6	14	13	6
July	27	502	149	8,710	9,361	12	11	0	86	2	3	0	14	14	0
From August 1st to November 30th Museum closed for Vacation and re-arrangement.															
December (Soulages collection open)	27	1,714	2,833	26,559	31,106	42	17	0	5	0	2	6	42	19	6
Total of 1856	210	4,576	3,683	103,509	111,768	£114	8	0	1,008	£22	10	3	£136	18	3
Total of 1855	231	3,598	893	73,936	78,427	£89	19	0	986	£17	7	2	£107	12	2

Total number of visitors, including visitors to Circulating Museum Collection (32,852), during the year 1856 . . 144,620
Total number of visitors during the year 1855 134,128

Increase in 1856 . . 10,492

IV.

Return of the Number of Visitors to Circulating Museum Collection in Provincial Towns, 1856.

Town.	No. of Visitors admitted by payment.	No. of Visitors admitted free.	No. of drawings made from the objects exhibited.	Total No. of Visitors.
Sheffield - - - -	3,681	1,254	147	4,935
York - - - -	3,112	982	—	4,094
Newcastle-on-Tyne - -	1,289	652	2	1,941
Carnarvon (North Wales) - -	561	749	2	1,310
Hanley (Potteries) - - -	18,793	1,779	83	20,572
Totals for 1856 -	27,436	5,416	234	32,852
In 1855 Birmingham, Nottingham, Macclesfield, Norwich, and Leeds furnished the following Totals -	44,949	10,752	699	55,701

V.

Additions to the Museum of Art, by Purchase, during the Year 1856.

SECTION I.—WORKS IN METAL, JEWELRY, &c.

No.		Price. £	s.	d.
4038	Circular bowl, bronze, damascened with silver, ancient Saracenic work. - - - - - - -	3	0	0
4039	Circular cover of a box or bowl, similar work. - -	2	0	0
4040	Buckle in bronze, gilt, chased with masks. 17th century work. - - - - - - - -	0	15	0
4043	Etui in chiselled steel. 16th century. - - -	8	0	0
4053	Circular medallion in silver, by Heinrich Reitz, of Leipsic, dated 1569. - - - - - -	25	0	0
4054	Ancient Saracenic damascened bronze vessel. - -	10	0	0
4055	Reliquary in silver gilt. Italian, circa 1560. - -	8	0	0
4056	German service book, with chased silver cover. Circa 1730.	10	0	0
4074	Bronze pricket candlestick. 13th century work. - -	7	0	0
4076	Small statuette in chiselled brass, Virgin and Child. 14th century work. - - - - - - -	1	12	0
4079	Engraved iron hand candlestick. 17th century work. -	2	8	0
4080 4081 4082	Three bronze relievo plaques. Italian quattro-cento work. -	4	16	0
4083	Surgical instrument. Italian, 15th century. - -	1	16	0

Appendix C.

REPORT OF CURATOR OF MUSEUM OF ART.

		Price. £	s.	d.
4086	Dagger, with hilt in chiselled bronze. Italian, 15th century.	11	4	0
4090	Boss or patera in chiselled bronze. Antique Roman work.	1	12	0
4091	Fragment in bronze, the handle of a lamp. Antique.	0	8	0
4092, 4093	Two knives. French; renaissance period.	1	12	0
4094	Pair of wrought-iron firedogs. French or Italian, 16th century.	10	0	0
4095	Crucifix clock. German, 17th century work.	6	0	0
4096	Hexagonal saltcellar in gilt bronze. Italian, circa 1500.	4	16	0
4099	Silver seal. French or Italian, circa 1300.	1	16	0
4211	Iron coffret. 15th century work.	8	2	0
4217	Circular bronze bas-relief, Flight into Egypt. Italian work, circa 1500.	8	0	0
4229	Circular bowl with cover, Saracenic damascene work.	3	12	0
4223	Bronze ewer, French, circa 1570.	3	0	0
4224, 4225, 4226	Three antique bronze fragments, portions of ornamental armour from a bronze statue.	8	0	0
4228	Enamelled gold bracelet, French, circa 1520.	18	0	0
	Eight Italian cinque-cento medallions, various historical personages.	19	18	6
	Italian chiselled iron door knocker, 16th century.	16	16	0
	Screen and two pediments in wrought iron, German, 17th century work.	55	0	0
	Pair of wrought-iron hinges, German, 17th century.	4	0	0
	Iron grating from a window of the Cathedral of Ghent, Circa 1520.	2	12	0
3236	German, 17th century watch with silver enamelled dial and crystal cover.	4	0	0
3551, 3552	Old English stove grate and fender, 18th century work.	6	10	0
3553	Pair of bronze and or-moulu Venetian firedogs, circa 1700.	5	0	0
3549	Chamberlain's gilded key of office, German, 18th century.	1	5	0
3550	17th century, chiselled iron key.	0	8	0
3345, 3346	Pair of antique Greek gold fibulæ.	10	0	0
3347	Antique gold earring.	9	15	0
3343, 3344	Three antique bronze vase handles.	1	4	0
1260	Bronze medallion of Sir C. Wren.	1	10	0
3576	Lock and hasp, German, 17th century work in engraved steel.	1	4	6
3605	Jewel or pilgrim's badge, in silver gilt, circa 1500.	2	4	2
3635	Fluted silver cup, old English, 17th century.	7	0	0
3636	16th century engraved silver goblet.	5	0	0
3637	Silver gilt tankard, 17th century work.	12	12	0
3638	Octagonal silver-gilt basin, 17th century.	6	6	0
3640	Compass in silver-gilt case, dated 1589.	6	0	0
3642	Pair of Italian 17th century scissors.	1	1	0
2735	Saracenic damascened bronze bowl.	7	18	0
2734	Similar bowl of more elaborate work.	33	0	0
2697	Chinese bronze incense burner.	3	10	0
2696	Chinese bronze damascened vase.	7	0	0
2698	Chinese bronze vase.	1	11	6
2727	Chinese circular bronze box.	1	8	0
2729	Ancient Chinese bronze vase.	1	15	0
2730	Engraved and gilded bronze cup, Chinese work.	1	9	0
	Venetian cinque-cento chiselled iron door knocker.	16	16	0
3038	Embossed brass "Couvre feu," 16th century work.	12	0	0
3634	Wrought-iron cartouche ornament, dated 1599.	5	0	0
3610	Plaque, Italian damascene work on iron.	3	0	0
3270	Gold medal of Pope Paul III.	7	0	0

SECTION II.—POTTERY AND GLASS.

No.		Price. £	s.	d.
4065	Bas-relief, The Annunciation, in enamelled terra cotta, "Della Robbia" ware.	33	1	6
4070	Majolica ware plate. Circa 1510.	12	0	0
4227	Circular medallion relievo in blue glass; cinque-cento work.	0	8	6
4230	Group of three singing angels in terra cotta, "Della Robbia" ware.	12	0	0
4231	Majolica plate, Gubbio or Faenza, circa 1530.	2	16	0
4232	Hispano-Moresco lustre ware plateau, 15th century.	8	0	0
4235	Bas-relief in Italian enamelled terra cotta.	12	0	0
4236	Japan porcelain bowl.	0	15	0
4237	Painted glass window. 15th century work.	25	0	0
	Majolica ware arabesque plate.	1	10	0
	Parian porcelain jug, recent Staffordshire ware.	4	0	0
3263, 3264	Pair of Chinese porcelain vases, painted with Iris flowers.	4	0	0
3457	Old Bohemian engraved glass goblet.	2	0	0
3451	Old Bohemian glass milk ewer.	1	0	4
3349	Cup in purple glass, decorated in white enamel, 18th century.	0	5	0
3548	Old Dresden porcelain cup and saucer.	0	10	0
3557 to 3567	Seventeen pieces of modern Staffordshire earthenware and porcelain, manufactured by Minton & Co. Various recent designs.	103	11	0
3579	Sèvres pâte dure dejeuné service, painted with animals.	31	10	0
1261	Vase and cover, "Karl-Theodore" porcelain.	6	10	0
3639	Majolica plate painted with arabesques	10	0	0

SECTION III.—TEXTILE FABRICS.

4045, 4046, 4047	Ancient embroidered chasuble, 15th century work. Embroidered stole, 15th century. Chasuble in embroidered velvet, 15th century work.	13	0	0
4059	Piece of Italian silk stuff, 15th century.	1	1	0
4061	Square panel of ancient figured velvet, Spanish or Italian, circa 1500.	4	0	0
4062	Embroidered velvet purse, 17th century work.	1	10	0
4216	Panel of Italian needlework tapestry. 15th century.	8	0	0
4218, 4218, 4220	Three pieces of ancient Italian point guipure.	2	4	0
4142 to 4210	70 pieces of modern textile fabrics and articles of costume from the Greek Archipelago.	20	0	0

SECTION IV.—VARIOUS.

4041	Plaque in champ-levé Limoges enamel, 13th century.	3	10	0
4042	Bowl of a tazza, Limoges painted enamel, by Leonard Limosin.	3	0	0
4044	Carved and gilded picture or mirror frame, cinque-cento period.	6	0	0
4049	Cabinet in carved oak, French renaissance work.	15	0	0
4050	Similar cabinet.	15	0	0
4051	Similar cabinet of more elaborate work.	30	0	0
4052	Cabinet or cupboard in carved oak, modern French.	4	0	0
4060	Ancient Japan lacquered box.	1	15	0
4057	Lutheran Bible in rich binding, dated 1583.	10	0	0
4063	Carved and gilded picture frame, Louis XVI. period.	1	10	0
4064	Crucifix on pedestal in carved amber, 17th century work.	15	0	0
4073	Circular box in turned ivory with bronze-gilt lock and hinges. 13th century work.	9	12	0

Appendix C.

REPORT OF CURATOR OF MUSEUM OF ART.

No.		Price. £	s.	d.
4075	Plaque in carved ivory, part of a coffret, 13th century.	1	12	0
4077	Statuette in carved boxwood, Virgin and Child, 14th century work.	6	0	0
4084	Statuette in marble, French, 15th century work.	4	16	0
4085	Circular pendant badge in carved stag-horn, mounted in silver gilt, circa 1500.	1	12	0
4087	Harp, richly carved and gilded and painted with arabesques, Period of Louis XVI.	16	0	0
4088	Case for a missal or psalm-book in polished wood, inlaid with pearl marqueterie, circa 1700.	2	8	0
4089	Pearl oyster-shell carved with the Crucifixion, circa 1480.	2	8	0
4097	Plaque, Rhenish champ-levé enamel, 12th or 13th century.	12	0	0
4098	Antique circular enamelled bronze fibula.	2	0	0
4101	Piece of German wood carving, circa 1490.	2	0	0
4139	Circular box in ivory, Mediæval Arabic or Saracenic work.	7	0	0
4142 to 4210	Series of textile fabrics, articles of costume, &c., from the Turkish Archipelago, 69 pieces.	20	0	0
4213	Fragment of a relievo in carved boxwood, Mediæval romance subject. Circa 1480.	2	16	0
4215	Carved and gilded Italian mirror frame, cinque-cento period.	10	0	0
4221	Folio binding of a book in morocco, period of Louis XIV.	0	6	0
4229	Comb in boxwood, inlaid with marqueterie, French, c. 1520.	8	0	0
4233	Relievo, Virgin and Child, in statuary marble, Italian, quattro-cento work, attributed to Donatello.	80	0	0
4234	Bas-relief in carved stone, Holy Family, Italian quattro-cento work.	15	14	0
4238	Carved oak cabinet, Flemish work, circa 1620.	18	0	0
4239	Door, with architrave, pediment, &c. complete, inlaid with marqueterie, Flemish, dated 1580.	25	0	0
4240	Bracket in carved oak, 16th century.			
4241	Carved oak panel, 16th century work.			
4243	German Bible in rich binding, dated 1629.	12	0	0
4244	Coffret in carved wood, Flemish, circa 1470.	6	0	0
	Four statuettes of saints in carved oak, German, 14th century work.	3	3	0
3342	Italian carved and gilded picture frame.	1	10	0
3338	Antique intaglio in sardonyx, Head of Julia.	4	0	0
3339	Intaglio in crystal, Inigo Jones, English, 17th or 18th century work.	1	10	0
3265	Coffret in carved bone and marqueterie, Italian, quattro-cento work.	38	0	0
3264	Triptych in carved and painted wood, Flemish, 15th century work.	14	0	0
3348	Antique Roman marble vase with cover.	42	2	0
3577 3578	Two cinque-cento Italian illuminations on vellum.	6	16	6
3606	Book in rich morocco binding, 17th century.	0	12	6
3641	Small cup and cover in German onyx mounted in silver gilt.	3	0	0
2731	Chinese Cloisonné enamel incense burner.	32	11	0
2733	Octagonal cistern in Chinese Cloisonné enamel.	39	0	0
2732	Chinese Cloisonné enamel vase.	17	0	0
2728	"Bonbonnière" in avanturine glass and bronze gilt filagree work.	1	10	0
2720 2721	Two carved rhinoceros horn cups, Chinese work	2	4	0
4034	Flemish, 17th century, carved oak bedstead.	11	0	0

VI.

LOANS TO MUSEUM.

TUPPER, A., Esq.

Lock and key in chiselled iron. 15th century work.

FIELD, G. Esq.

Green jade tazza, with enamelled gold mounting.
Engraved rock crystal vase. Italian, cinque-cento work.
Draped female figure in carved ivory.
St. Sebastian, statuette in carved ivory. Italian, 16th century work.
Group of the Seasons in ivory. Flemish, 17th century.
Statuette of the Virgin in boxwood. 16th century.
Book of Prayers in gold enamelled cover. Elizabethan period.
Table clock in silver, set with rubies, &c.
Two ivory knife handles.
Two boxwood carvings, landscapes. French, 17th century.
Carving in boxwood, Adam and Eve. German renaissance.
Two carvings in wood, by De Montreuil.
Carved boxwood frame, with miniature. 18th century.
Carved boxwood watch-stand. 18th century.
Plaque of sculptured ivory, Descent from the Cross, Italian, 17th century work.
Ivory carving in 16 compartments, representing the Passion of Christ, 14th century work.
Coffret in Limoges enamel.
Plaque in Limoges enamel, the Cumæan Sybil.
Rosary bead in carved boxwood.
Pair of salt cellars in Limoges enamel.
Top of a walking-cane in carved ivory.
Similar one in boxwood.
Pair of nut-crackers in carved boxwood.
Dejeuné service in old Dresden porcelain.
Two Sèvres pâte tendre cups and saucers.
Salt-cellar in "Henri-deux" ware,—mustard pot in old Flemish stoneware.
Two cruches in old Grès de Flandres.
Four statuettes of amorini in carved boxwood, period of Fiammingo.
Two chairs in ebony, inlaid with ivory.
Coffer and stand in carved ebony.
Group in terra cotta, 18th century.
Statuette of an amorino in carved ivory.
Pair of groups of amorini in carved ivory, attributed to Fiammingo.
Pair of Venetian glass bottles with gilt metal mounts.
Vase clock in or-moulu and silver, Venetian, 16th century.
Group in carved ivory, 17th century work.
Vase, Venetian glass.
Pair of vases in carved ivory, mounted in or-moulu. Attributed to Goutiere.
Marqueterie encoignure, by Riesner.
Two groups of amorini in marble, 17th century work.
Cylindrical vase in carved ivory, Flemish, 17th century work.
Pair of bronze Venetian candlesticks, 16th century work.
Statuette of a boy in carved ivory.
Two statuettes of amorini in boxwood, style of Fiammingo.
Pair of miniature columns in jasper supporting statuettes in gilt bronze, Italian cinque-cento work.
Wood-carving, group of game. By Lienard.
Venetian glass cruet.
Pair of silver salt-cellars.
Knife and fork with carved ivory hilts.

Appendix C.

REPORT OF CURATOR OF MUSEUM OF ART.

Watch stand in carved wood.
Ebony cabinet inlaid with ivory. Italian, 16th century work.
Collection of twenty-five Dutch and Flemish cabinet pictures.

STANHOPE, H. S., Esq.

Three majolica plates. By M. Giorgio, F. Xanto, &c.

WHITEHEAD, J. M., Esq.

Antique Roman bronze mask.

GOSFORD, The Earl of.

Two majolica plates. By M. Giorgio.

CAMPBELL, Sir H. H., Bart.

Anatomical figure in wax. Attributed to Michael Angelo

MASKELL, W. Esq.

Cocoa nut cup, mounted in silver gilt, old English work.
Plaque of cinque-cento repoussé iron work.

HAMILTON, His Grace the Duke of.

Large circular plateau, modern Sèvres enamel.
Moulded blue glass goblet.
Terminal pedestal and bust in old Rouen faïence.

Library Report, 1856.

In the seven months during which the Library was open to the Public in 1856, the Subscribers have been 207, and the visits 5,346; being an increase of 38 Subscribers and 558 visits over the corresponding period of 1855.

The Library was closed for removal during the last three months of the year.

Upwards of 480 volumes have been added to the Collection during the year. Amongst them are the following:—

Calliat et Lance.—Encyclopædia d'Architecture, 4to. Paris, 1851, *et seq.*

Chamberlaine J.—Original Designs of the most celebrated Masters of the Bolognese, Roman, Florentine, and Venetian Schools, in His Majesty's Collection: engraved by Bartolozzi and other eminent engravers. With biographical and historical sketches of L. Da Vinci and the Caracci, folio. London, 1796–1812.

——————— Imitations of Original Drawings by Hans Holbein, in the Collection of His Majesty, for the Portraits of Illustrious Persons of the Court of Henry VIII. With biographical tracts, 83 Plates, 2 vols. folio. London, 1792.

De Caumont, A.—Bulletin Monumental, 22 vols. 8vo. Caen, 1834, *et seq.*

De Magny and De Givodan.—Livre d'Or de la Noblesse Européenne, 5 vols. 4to. Paris, 1844–52.

Cathedrals.—Plans, Elevations, and Sections of Durham, Gloucester, and Exeter Cathedrals, of St. Alban's Abbey, St. Stephen, Westminster, and Bath Abbey Church. Published by the Society of Antiquaries, 2 vols. folio. London, 1797–1813.

Feydeau, E.—Histoire des Usages Funèbres, et des Sepultures des Peuples Anciens. Ouvrage publié sous les auspices de M. le Ministre de l'Instruction Publique et des Cultes, 4to. Paris, 1856.

Fossati, G.—Aya Sofia, Constantinople, as recently restored by order of H. M. the Sultan Abdul Medjid, folio. London, 1852.

Gori, A. F.—Thesaurus veterum Diptychorum, consularium, et ecclesiasticorum, 3 vols. folio. Florentiæ, 1759.

Gregorian Museum.—Musei Etrusci quod Gregorius XVI. Pon. Max. in Ædibus Vaticanis constituit. Monimenta linearis picturæ exemplis expressa et in utilitatem studiosorum, antiquitatem, et bonarum artium publici juris facta, 2 vols. folio. Rome, 1842.

King, E.—Munimenta Antiqua: or Observations on Antient Castles. Including Remarks on the whole Progress of Architecture, Ecclesiastical as well as Military, in Great Britain, 4 vols. folio. London, 1799–1805.

Kip, J.—Nouveau Théâtre de la Grande Bretagne, 3 vols. folio. London, 1715.

Laxton, H.—Examples of Building Construction: intended as an aide-memoire for the Professional Man and the Operative, being a Series of Working Drawings to a large scale, exemplifying the Arrangements and Details adopted in carrying out the several branches of trade requisite for Public and Private Edifices, Atlas folio. London, 1854, *et seq.*

Louvre.—The Collection of Engravings comprising the Calcography of the Imperial Museum of the Louvre. 39 vols. Atlas folio; 1 vol. 4to text, (catalogue). Paris, 1655 to 1855.

Mackenzie, F.—The Architectural Antiquities of the Collegiate Chapel of St. Stephen, Westminster, the late House of Commons, Atlas folio. London, 1854.

Ottley, W. J.—An Inquiry into the Origin and Early History of Engraving, upon Copper and in Wood. With an Account of Engravers and their Works, from the Invention of Calcography by Maso Finiguerra, to the time of Marc'Antonio Raimondi, 2 vols. 4to. London, 1816.

Saunders, F. H.—Illustrations of the British Paper Manufacture, 1855, 4 vols. Atlas folio. London, 1855.

Viel-Castel, Le Comte Horace.—Collection des Costumes, Armes, et Meubles, pour servir à l'Histoire de France depuis le commencement du V^me^ siècle jusqu' àu nos jours, 4 vols. 4to. Paris, 1827–45.

Appendix C.

REPORT ON LIBRARY OF ART.

TABLE I.—VISITS to the LIBRARY.

	1853.	1854.	1855.	1856.	
January	153	934	794	871	
February	120	853	705	928	
March	181	799	665	590*	* 18 days.
April	197	465	393	737	
May	121	844	677	565*	* 20 days.
June	225	774	711	847	
July	322	769	843	808	
August	215	—	—	—	} Vacation.
September	85	—	—	—	
October	923	895	828	—	} Closed for removal.
November	912	954	938	—	
December	771	655	688	—	
Total	4,425	7,942	7,242	5,346	

Total number of visits from January 1 to December 31 :—

1853	292 days	4,425
1854	248 „	7,942
1855	245 „	7,242
1856	168 „	5,346

Average daily attendance :—

1853	15
1854	32
1855	30
1856	32

TABLE II.—SUBSCRIBERS to the LIBRARY.

	1853.	1854.	1855.	1856.
January	3	33	21	45
February	2	28	23	38
March	5	29	25	26
April	3	22	19	35
May	4	23	26	16
June	5	13	24	27
July	21	12	31	20
August	15	—	—	—
September	11	—	—	—
October	37	25	49	—
November	43	30	40	—
December	21	20	26	—
Total	170	235	284	207

Total number of subscribers for,—

1853	12 months	170
1854	10 „	235
1855	10 „	284
1856	7 „	207

R. LASKEY,
Clerk to the Library.

Appendix C.

Report of Director of Museum of Irish Industry.

Report of the Condition and Progress of the Museum of Irish Industry and the Government School of Science applied to Mining and the Arts, Dublin, for the Year 1856, by Sir Robert Kane, F.R.S., M.R.I.A., Director.

The collections of the Museum have been considerably increased during the past year, and further progress has been made in their systematic classification, and in the arrangements for preparing the catalogues.

The increase of the collections has been, in a great degree, made by donations, which have been presented in a very liberal manner by manufacturers and others in Ireland, and in Great Britain; particulars as to such donations will be found in the Appendix. A number of objects of importance for the purposes of scientific and industrial illustration, but which could not be obtained by donation, have been purchased for the Museum; and in many instances, where series of specimens of great extent and value have been required to render the representation of certain industrial arts properly complete, the manufacturers have arranged to supply such collections, charging only the first cost of the materials and labour, which constituted but a small part of the expenditure, in time and trouble, which the preparation of such series involved. It has been very gratifying to meet, almost without exception, among the principal manufacturers, such full appreciation of the value of the Museum of Industry as a means of promoting industrial knowledge, and improving industrial skill and taste, and so much willingness to co-operate, even at considerable expense and trouble, in carrying into effect the objects of the Department of Science and Art in the further development of the Institution.

A very useful means of obtaining this important increase to the collections has been by the journey which the chemist of the Museum, Dr. Sullivan, was authorized to make to the manufacturing districts, for the purpose of affording, personally, explanations as to the objects of the Museum, and of arranging on the spot for the collection and transmission of donations. The result proved, as already stated, eminently satisfactory, both as regards the supply of specimens, and as serving to diffuse among the manufacturers additional information as to the arrangements now in progress for the advancement and diffusion of industrial education.

In order to illustrate more definitively the progress made in the Museum during the past year, I shall refer briefly to each of its principal divisions, following the order observed in the general classification adopted in the galleries.

1. *Minerals and Rock Specimens.*

Considerable additions have been made in this department during the past year, by the purchase of models, in strass, of the more important precious stones, representing the common modes

Appendix C.
REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

of cutting those stones, and also models of the largest known diamonds in the same material. 2. A collection of real precious stones (amongst them, diamonds), both in the natural and cut state. 3. Some specimens of jaspers and agates, calcedonys, gypsum, fluor spar in polished slabs and wrought into ornaments, &c. (*See* complete list annexed). 4. Purchased from Dr. Krantz of Bonn, a good and instructive collection of 666 specimens of igneous and altered rocks. 5. From J. Beete Jukes, Esq., Director of the Geological Survey of Ireland, a series of several hundred rocks, fossils, and minerals. 6. A series of pseudomorphous and other minerals, chiefly from the Co. Donegal, have been purchased.

2. *Metallurgic Collections.*

In this department the additions have been both numerous and important; as the following summary will indicate:—

27 specimens illustrative of the manufacture of Low Moor iron, presented by Mr. Fenton, manager of Messrs. Hird, Dawson, & Hardy, Low Moor Works, Bradford, Yorkshire; 20 specimens of iron ore used on the Tyne, inclusive of the Oolite ores of Whitby; 17 specimens illustrative of iron smelting and puddling; 40 specimens of rails, angle, square, and round iron, made at the Walker Iron Works, presented by Messrs. Wilson, Losch, & Bell, Newcastle-upon-Tyne. The first instalment of a large and valuable series illustrative of the manufacture of cast-steel cutlery and edge tools, presented by W. Matthews, Esq. (Curton & Sons), Sheaf Works, Sheffield, has also been received.

Extensive collections have been formed with the assistance of the Messrs. Elkington, of Birmingham, of the materials, processes, implements, and objects of finished manufacture of the various applications of electrotyping with copper and electroplating on copper and on German silver, and of silver ornaments in filligree work, by Messrs. Allen and Fulton, of Birmingham.

The various modes of manufacture by rolling and casting of brass, copper, and German silver, are also illustrated by series of specimens.

3. *Chemical Manufactures.*

Materials have been obtained for the purpose of preparing a series of illustrations of chemical products, which are not to be procured of sufficient purity in commerce; and these specimens will be deposited in the collections according as the chemical officers shall have them in proper state for exhibition.

The Price's Patent Candle Company have added to the valuable donations they had previously made by sending, through Mr. George Wilson, a series of specimens, illustrative of the new and interesting applications of glycerine.

4. *Glass and Ceramic Manufactures.*

Messrs. Minton, Hollis, & Co., through the able director of their manufacture, Mons. Arnoux, who had already acted with such generosity to our Institution at the time of the Dublin Exhi-

bition, have given, on this last occasion, a new proof of their willingness to serve the cause of industrial education. Mons. Arnoux not only gave to the chemist of the Museum his valuable advice in the collection of the materials serving to illustrate the manufacture of Ceramic arts, but he also undertook the preparation of a number of specimens illustrative of the recent progress of the Ceramic manufactures in an artistic point of view. These objects reflect the highest credit on all the gentlemen concerned, both as manufacturers and artists.

Messrs. Chance, Brothers, & Co., besides preparing a very interesting series of specimens illustrative of the manufacture of crown glass, and of optical class, have also presented us with a number of specimens of fused basalt, both glassy and divitrified, which possess great interest, both scientifically and practically, especially in this country.

5. *Animal and Vegetable Materials.*

A very valuable and extensive series of specimens illustrating the various applications and modes of manufacture of Indian-rubber (caoutchouc) in the arts, has been presented by Messrs. Charles Mackintosh & Co. This series includes all the chief uses of that valuable substance; and the importance of this, otherwise highly interesting, collection is considerably enhanced by the indications of the localities from whence the different varieties of the materials have been obtained.

A similar series, nearly as extensive, has been presented by the Gutta Percha Company, illustrating the industrial uses of that important material. Every specimen in those collections possesses individual interest, either in an economic or an artistic point of view.

6. *Textile Fabrics.*

Messrs. Titus Salt, Sons, & Co., Bradford, deserve special mention, not only for the valuable collection which they have already sent, but also for the readiness with which they have undertaken to extend it, and render it at once worthy of the founders of the great alpaca industry, and of a great Technological Museum; and the Museum is indebted to Messrs. Marshall, of Leeds, for a series of specimens illustrative of the preparation and spinning of China grass, and of the improved mode of preparing flax fibre by Mr. Jenning's process.

7. *Mechanical and Mining Models.*

Arrangements are in progress for providing such a collection of models of industrial and mining machinery, as may serve to illustrate more completely the history of those arts as shown by the collection in the galleries, and may enable the Professors to complete their Lecture instructions in this regard. The models already procured, are:—

1. Clarke's linen lapping machine.
2. Series of eight models of looms, exhibiting the details of the manufacture of gymp, fringe, silk velvet, poplin or tabinet;

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REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

Jacquard-figured poplin, carriage lace and saddle girths, and stair carpetting on the Jacquard construction.

3. Series of seven models of the machinery employed in the pottery and porcelain manufactures.

4. Model of section of mine shaft and working machinery, including horse-whin capable of working two ropes and kibbles by continuous motion. Model of man-machine, as used in some of the deep Saxon mines, combining the ladder system, and enabling a shift of miners to descend while another is ascending.

Details of other donations and of objects purchased, will be found in the Appendix.

Progress and Arrangement in Classification.

When in sufficient number, the specimens belonging to each special collection, have been, as much as possible, classified in such a way as to show the various stages of manufacture, and their uses; such classification will be rendered gradually more inteligible, by the addition of good diagrams and models, showing the general process of manufacture.

In order to show what will be the final plan of arrangement, cotton may be taken as an example amongst the textile manufactures. There will be shown under this head—

Natural history, varieties of cotton plant (illustrated by diagrams).

Seed, leaves, pods, cotton seed oil.

Commercial varieties of raw cotton (illustrated by specimens).

Comparative value of each variety, and comparison between the fibres of cotton and the fibres used in other textile manufactures. (Microscopical drawings.)

Mechanical preparation of cotton, including spinning illustrated by specimens of the cotton in each stage, and by models of the machinery employed. Weaving, illustrated by models of the different forms of looms used in the cotton manufacture, and by specimens of a classified series of cotton fabrics.

Bleaching, illustrated by specimens; models of machinery and diagrams. Dyeing and printing, illustrated by specimens; models and diagrams. Waste of each branch of manufacture, and its useful applications.

Mr. Gages, the curator of the Museum, had undertaken at the beginning of the past year, a series of analyses for the determination of iron, &c., in the Belgian ores recently added to the collection, but the state of his health prevented him from terminating many of these analyses, and recently the more immediate and pressing duties of classification and labelling of the specimens. occupied all his time. Many important chemical substances which could not have been purchased, but were absolutely necessary as elements of the chemical collection, have been prepared.

The soils of the different Counties have been properly arranged, and the remainder of the Ordnance Survey collection has been put in a proper place.

The Museum galleries were open to the public on every week day throughout the year from 11 until 4 o'clock, and during those hours there visited the Museum from the 1st of January to 31st December, 15,329 persons.

The arrangements for lighting the galleries having been completed, they were also thrown open to visitors at night, from seven to half-past nine o'clock, during the times of delivering of the courses of lectures. The result has been extremely satisfactory, as it enables the very large class of persons who are occupied by business during the day, to devote more time to an examination of the objects in the Museum collections in the evening, besides attending such lectures as may be in course of delivery. The number of persons who thus visited the Museum in the evening was 16,282, making a total number of visitors in the year of 31,611.

The list of donations will be found annexed. List B.

The list of purchases, with prices paid affixed, forms List C.

Chemical Department.

The chemist to the Museum having been employed very much during the summer, in visiting the manufacturing districts of Great Britain, for the purpose of procuring specimens for the Museum, the analytical business of the laboratory was to a great extent suspended for the last year, as the remaining time of that officer was almost entirely taken up by the duties which devolved upon him as Professor of Chemistry in the Government School of Science, and by the arrangements of the Class of Practical Chemistry, which was conducted by him in the laboratory of the Museum. I have not, therefore, to report any advance in the chemical investigations, as to the composition of certain rocks, and of certain agricultural roots, to which I referred in my last report as being in progress. But the new arrangements which have been made by the authorities of the Board of Trade in this department of the Museum, will, as I believe, have the effect of enabling the chemical officers to devote themselves in future to the special business of the laboratory and museum, with less interruption, and with increased advantage to science, and to the public service.

Library.

I have the honour further to report, that during the present session the library of the Museum has been rendered available for the purposes of scientific study by the registered pupils of the Government School of Science, and with very satisfactory results. The hours of reading are in the evening from seven till nine, and although open as yet only since the 3rd of November, it has been attended by 501 persons, giving an average attendance of 13 persons on each night. The conduct and attention of the students using the library has been quite unexceptionable.

Government School of Science applied to Mining and to the Arts.

The system of industrial education which is carried out in the Museum of Irish Industry, has made considerable progress, and attained satisfactory success during the past year. An important

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REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

means of conferring additional completeness on the courses of lectures delivered in the Museum, has been afforded by the arrangement of including in the systematic courses, the public introductory courses delivered, under the authority of the Committee of Lectures, in the theatre of the Royal Dublin Society, as well as in this Museum; so that the students having attended in these public courses the more general and elementary portions of the subjects, the Professors are enabled to commence the more special portions of their systematic courses at the higher level, thereby obtained, and consequently to carry out, in the theatre of this Museum, a much more complete plan of instruction than would be possible in the same time if they were obliged to recommence the elementary portions of their subjects in the Museum theatre, after having discussed them already in the popular public lectures, given in the Royal Dublin Society. I beg to report that the co-operation of the committee of lectures, thus considerately and opportunely afforded, has been of much value; and that the Royal Dublin Society also has on every occasion given to the Professors all the facility and assistance in its power, for carrying on the lectures which are delivered on its premises. The authorities of the department having decided on conceding to the members of the Royal Dublin Society the privilege of free admission to all lectures delivered in the Museum, an arrangement which I had the honour to recommend, a special book has been provided for the names of all members attending at any of the systematic courses of lectures.

In last report I mentioned that the business of the educational session of 1855-56 was commenced on November 1st, 1855, when I delivered an opening address explanatory of the educational arrangements. The proceedings up to the close of the year have been sufficiently detailed in my last report, and I shall, therefore, here only refer to the business of that session from the commencement of the past year.

On the 7th of January, Dr. Sullivan commenced the second portion of his systematic course of lectures on chemistry, which continued to the end of February. The total number of attendances was 941, and the average 47. The number of admission tickets sold was 145 of which 65 were for the entire course, the fee being 2*s.* 6*d.*, and 80 were for admission to the subdivisions of the lectures, for which 1*s.* admission was charged. At the end of the course an examination for prizes was held, at which 21 persons competed. The result will be found described elsewhere.

On the 12th January, Mr. Jukes commenced the second part of his systematic course of lectures on geology, which continued to the close of the following month. The total number of attendances was 838, and the average 41. The number of admission tickets sold was 97, of which 43 were for the entire course at 2*s.* 6*d.*, and the remaining 54 were for the parts of 10 lectures at 1*s.* fee. At the close of the course the examination was held, and 16 persons competed.

On March 3, Dr. Barker commenced his course of 30 lectures on natural philosophy, which continued to near the end of the next month. The total number of attendance was 1,805, and the

average 60. There was sold 123 admission tickets, 51 being for the entire course at 2*s.* 6*d.*, and 72 for admission to the parts at 1*s.* At the examination for prizes at the end of the course 37 students competed.

In the absence of Dr. Harvey, Professor of Natural History, who was engaged in a scientific voyage in Polynesia, the duties of that department were very ably discharged, under the authority of the Board of Trade, by Dr. Kinahan, who commenced his systematic course of lectures on March the 4th, and continued them till towards the close of April. The total number of attendance was 738, and the average 26. There were sold 66 tickets, of which 22 were for the entire course at 2*s.* 6*d.*, and 44 for the part of 10 lectures at 1*s.* There competed at the examination for prizes at the close of the course 15 students.

When the four systematic courses had been terminated the general examination for prizes in the collective subjects was held, at which seven candidates competed.

In each class examination, and at the general examination, certificates were awarded to those of the competing students who attained to such a standard of proficiency in the subjects as the Professors considered satisfactory. The number of certificates and prizes given, will be found given in the Lists appended, and also copies of the examination papers employed.

On the 28th May the systematic business of the session was closed by the conferring of the prizes and certificates which had been thus obtained. This meeting was honoured by the presence of his Excellency the Earl of Carlisle, Lord Lieutenant, who was pleased to express much interest in the progress of the Museum, and of the objects of the Department generally, and to lend additional importance to the honours awarded, by himself conferring them upon the successful candidates. The proceedings on that occasion had been opened by an explanation from me, as Director, of the nature of the educational arrangements and of the examinations that had been held, and his Excellency, in concluding the ceremony, addressed to the students present some observations of encouragement and advice, which I have the honour to annex, as reported at the time (D). The names of the successful candidates, and copies of the examination papers, are also annexed (Lists E. and F.).

On the 2nd June, Dr. Sullivan commenced, in the theatre of the Museum, a course of 12 public lectures on chemistry, which were attended by an average of 129 at each lecture; and, on June 3rd, Dr. Kinahan commenced his course of 12 public lectures on natural history, which were attended by an average number of 68 at each lecture.

A course of lectures and demonstrations in practical chemistry was conducted, during the session of 1855–56, in the laboratory of the Museum, by the chemist, Dr. Sullivan, which occupied 73 evenings. The number of students who attended was 11, and the fee paid was 1*l.* Under the circumstances, this class must be considered as having had satisfactory success.

The educational arrangements of the present session were com-

Appendix C.

Report of Director of Museum of Irish Industry.

menced on October 9th, 1856, when an address was delivered by me on the "Recent Progress of the Industrial Sciences," on which occasion 450 persons attended.

It being arranged (as will be found detailed in the programme annexed, Appendix G.) to have distinct series of courses delivered in the day time and in the evening, in order to accommodate and provide for the instruction as well of the artizan and other classes who are necessarily employed by business during the day, as well as to suit those classes who are able to devote the day to purposes of study and education, the early part of October was occupied by day lectures at the Royal Dublin Society's House, of which it is not my province to report, and the evening courses were opened on the 27th October, when Mr. Jukes commenced his course of 20 systematic lectures on geology and physical geography. Of this course the first 12 were free, and were attended by an average of 291 persons; for the remaining eight lectures a fee of 6*d.* was charged, and they were attended by an average of 124. There were sold 168 tickets, and at the end of the course 33 students entered for examination for prizes and certificates.

On November 25th, Dr. Sullivan commenced his systematic course of 20 lectures on chemistry. Of this course the first 12 were public, and were attended by an average of 279 persons; and the remaining eight lectures, for which a fee of 6*d.* was charged, was attended by an average of 103 persons. There were sold 170 tickets, and at the close of the course 30 students entered to compete for prizes at examination.

For the purpose of more distinctly comparing the relative results of the educational operations of the past with those of the preceding year, the following summary of the numbers is given in Table A.

On comparing those results as to numbers attending, and of those competing at examination for prizes, with the numbers who entered for the corresponding courses and examinations in the preceding session, there will be found in every instance considerable increase, manifesting the degree in which those arrangements of the Department for the Improvement and Extension of Education in the Industrial Sciences have been appreciated and availed of by the public, and especially by the classes in this city for which industrial education is most specially and practically required.

For more detailed information, I have the honour to annex a copy of the programme of the educational arrangements for the current session.

(Signed) Robert Kane, *Director.*

TABLE (A.)

1855.

	Total No. of Visitors.
Number of Visitors to the Museum during the day hours, from 1st January to 31st December 1855	14,416
Mr. Jukes's Paid Lectures	895
Dr. Allman's Ditto	302
Dr. Sullivan's Ditto	348
Dr. Barker's Ditto	436
Sir Robert Kane's Address	410
Dr. Barker's Free Lectures	4,365
Mr. Jukes's Ditto	2,414
Dr. Sullivan's Systematic Lectures	842
Mr. Jukes's Ditto	580
	25,800

1856.

	Total No. of Visitors.
Number of Visitors to the Museum during the day hours, from 1st January to 31st December 1856	15,329
Mr. Jukes's Systematic Lectures	838
Dr. Kinahan's Ditto	738
Dr. Sullivan's Ditto	941
Dr. Barker's Ditto	1,805
Sir Robert Kane's Address	450
Dr. Sullivan's Free Lectures	1,557
Dr. Kinahan's Ditto	822
Dr. Sullivan's Systematic Lectures	4,180
Mr. Jukes's Ditto	4,491
Number of Persons attended Distribution of Prizes	460
	31,611
	25,008
Increase	6,603

Number of Persons competing for Prizes.

Session of 1855-56.		Session of 1856-57.	
Chemistry	21	Chemistry	3
Natural Philosophy	37	Natural Philosophy	—
Geology	16	Geology	33*
Natural History	15	Natural History	—
General Examination	7	General Examination	—

* The above are the only two Examinations that have been as yet held during the current Session.

Appendix C.

REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

(B.)

LIST of DONATIONS made to the MUSEUM of IRISH INDUSTRY, from the 1st January to the 31st December 1856.

27 Specimens illustrative of the manufacture of Low Moor iron.
Presented by Mr. Fenton, manager to Messrs. Hird, Dawson, and Hardy, Low Moor Works, Bradford, Yorkshire.

27 Specimens of iron ore used on the Tyne, inclusive of the Oolite ores of Whitby.

17 Specimens illustrative of iron smelting and puddling.

40 Specimens of rails—angle, square, and round iron, made at the Walker Iron Works.
Presented by Messrs. Wilson, Losch, & Bell, Walker Iron Works, Newcastle-upon-Tyne.

First instalment of large series illustrative of the manufacture of cast-steel cutlery and edge tools.—Presented by W. Matthews, Esq. (Curton & Sons), Sheaf Works, Sheffield.

Specimens illustrative of the manufacture of twisted gun barrels.
Specimens of brown hematite found in the Co. Longford.
Presented by C. Miller, Esq., Dublin.

6 Specimens of plated-wire picture cord.
6 Specimens of gilded-wire do.
4 Specimens of patent copper wire.
Sash cord.
Presented by R. S. Newall, Esq., Gateshead-upon-Tyne.

Specimen of stereotype plate in copper, produced by electro-metallurgic process.—Presented by John Falconer, Esq., Dublin.

3 Specimens of prepared artificial manure, and specimens of stalagmitic phosphate of lime, apparently from old decomposed guano beds.—Presented by Messrs. Francis Ritchie & Sons, Belfast.

8 Specimens illustrative of the manufacture of patent siliceous stone, applied to architecture, &c.

1 Patent filter.
Presented by F. Ransome, Esq., Ipswich.

16 Specimens illustrative of the manufacture of white and red lead, &c.

24 Specimens of all the sizes of patent shot now made.
Presented by Messrs. Locke, Blackett, & Co., Newcastle-upon-Tyne.

6 Specimens illustrative of the products of the destructive distillation of wood, bones, and coal, &c.—Presented by Dr. E. Ronalds.

7 Specimens illustrative of the preparation of distilled glycerine, and its application, and palmitic acid.—Presented by Price's Patent Candle Co., Vauxhall, London, per George Wilson, Esq., manager.

25 Specimens of pottery materials; 11 specimens illustrative of the process of glazing under and over the glaze of earthenware; outside mould for cup and cup moulded; cup thrown and turned; do. handled; plaster plate mould; do. for handle of jug; a batter; 6 specimens of china, showing stages of the process of gilding; 4 specimens, showing the process of enamel decoration on the glaze; 15 slabs, showing "tints," after firing, of the selected colours produced by Mr. Minton; mould for casting head of Parian figure of Wellington; 2 heads cast in do., one fired and one unfired, to show the amount of contraction.

6 Specimens illustrative of the process of making encaustic tiles.
Presented by Messrs. Herbert Minton & Co., Stoke-upon-Trent.

Flower stand, vase, 2 truses, 5 bead mouldings, 2 pattern medallions, in fireclay terra cotta.—Presented by J. Wilks, Esq., Leeds.

Specimen of Rowley rag on basalt, in the natural state; do. fused into artificial obsidian plates of rolled obsidian; do. ornamented by means of hydrofluoric acid; fused basalt slowly cooled, showing devitrification; do. fully devitrified; figure of a lion cast in fused basalt and fully devitrified.—Presented by Messrs. Chance, Brothers, Glass Works, Birmingham.

Specimens illustrative of the manufacture of enamelled iron ware.—Presented by C. F. Griffith, Esq., Birmingham.

3 Alpaca fleeces of natural colours.

1 Fleece of Australian wool.

1 Fleece of mohair; 4 samples of combed alpaca and mohair, and a series of specimens of mixed alpaca fabrics.

Presented by Messrs. Titus Salt, Sons, & Co., Saltaire, Bradford, Yorkshire.

3 Series of specimens illustrative of the preparation and spinning of China grass, and of Jenning's process for improving the quality of flax, &c.—Presented by Messrs. Marshall & Co., Leeds.

Drawing of a cocoa walk and drying house at Trinidad.—Presented by Messrs. Fry & Sons, Bristol.

50 Specimens illustrating the manufactures in gutta percha.—Presented by the Gutta Percha Company, London.

72 Specimens illustrative of the manufactures in caoutchouc.—Presented by Messrs. Macintosh & Co., Manchester.

(C.)

LIST of SPECIMENS purchased and added to the MUSEUM COLLECTIONS, from the 1st of January to the 31st of December 1856.

	£	s.	d.
Rustic baskets and flower stands, made of different kinds of wood	1	5	0
One Flemish mug	0	7	6
One porcelain plate	0	12	6
Specimens of aluminum	12	16	0
Ditto of glass vases	1	6	6
Silver ornaments in filigree work	5	0	0
One filigree bracelet	1	15	0
Figure of Theseus electrotyped from the figure, reduced from the antique for the Arundel Society by Chevetoux	10	10	0
Indian tazza, ornamented with arabesque, &c., burnished silver upon oxidized silver ground, electrotyped on copper body, copied from original in the Marlborough House Collection by the electrotype process	5	0	0
666 specimens of igneous and altered rocks	31	7	0
Glass models of gems, coloured	2	10	0
Six glass models of diamonds (Pitt, Russian, Austrian, Nassuck, Pigott, and Koh-i-noor)	5	0	0
Four crystals of diamonds and one group of ditto	10	0	0
Crystal of emerald, and emerald in matrix	4	10	0
Oriental ruby, polished, and some rough pieces	2	0	0
Sapphire, polished, and eight crystals and fragments	2	0	0
Precious garnet, and six inferior specimens Cinnamon stone, polished, and ten specimens Zircon, polished, two crystals from Siberia Yellow topaz, polished, and three crystals Spinell ruby, polished, and six crystals Chrysolite, polished, and eight fragments Chrysoberl or Cymophane, polished, and fragments Turquoise and small fragments	7	0	0
Napoleanite, polished. Corsica	0	12	0
Malachite bracelet, and two specimens polished	4	0	0
Derbyshire fluor spar dish	0	15	0
Ditto purple fluor vase (very fine)	3	0	0
Two shells, with cameos cut on	1	5	0
Two cut amethysts	1	0	0

Appendix C.

REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

	£	s.	d.
Cat eye amethyst from Ceylon	0	15	0
Yellow and brown quartz, polished	1	4	0
Ribbon jasper. Siberia	2	10	0
Rough agate, partly polished. Oberstein	1	0	0
Ten polished agate handles, &c.	2	0	0
Lapis Lazuli, polished	1	0	0
Amethyst slab, polished	0	5	0
Two agate cups, polished. Oberstein	3	15	0
Moss agate, enclosing fossil sponge. India	2	10	0
Ribbon agate, polished. Oberstein	1	5	0
Agate beads, polished. Oberstein	1	10	0
Heliotrope, ditto. India	1	0	0
Fortification agate, polished. Oberstein	2	10	0
Calcedony, polished	1	0	0
Three flints, polished, from Brighton	1	16	0
Onyx agate for cameos	1	0	0
Agate cameos	5	0	0
Iceland spar, polished	2	10	0
Gypsum ornaments, and rough specimen	1	10	0
Twelve specimens illustrative of pinched glass making Eight ditto illustrative of glass grinding and cutting Two bone opal glass vases, painted with flowers in muffle colours (French) One water-jug (French) of frosted glass, in imitation of old Venetian frosted glass	3	12	0
Silver snuff box, ornamented in Niello at Ustzugweleeke, in Russia	0	15	0
Two cups and saucers, of antique Neapolitan Cape de Monte porcelain, with embossed and enamelled figures	5	0	0
Specimens of Australian gold	4	3	6
Two specimens of arragonite	0	4	0
Colours	0	13	6
Specimens of common domestic articles made of sycamore and poplar	0	9	6
Clarke's patent lapping machine	2	0	0
Series of eight models of looms, exhibiting the details of the manufacture of gymp, fringe, silk velvet, poplin or tabinet, Jacquard figured poplin, carriage lace and saddle-girths, and stair carpeting on the Jacquard construction	56	0	0
Model of section mine shaft, and working machinery included	18	10	0
Specimens of old Venetian point lace	1	0	0
Ditto of gold	2	6	2
Specimens of wine decanter and jug, &c.	2	7	0
One engraved wine glass	0	3	6
Sixteen bottles of materials	1	5	0
One cut wine glass	0	2	0
One canary do.	0	3	0
One ruby do.	0	5	0
Sixteen specimens, showing the successive stages of stamping, floating, lacquering, &c.; stamped brass work; model in lead of steel die for stamping brass; six specimens of composition of block tin; gas tubing made by drawing process; specimens illustrative of the manufacture of rolled brass tubing, viz.— Piece of ingot of copper Ditto zinc Ditto brass Whole flat ingot of brass for rolling Do. rolled for manufacture of tubing Fifty-three specimens of plain, twisted, fluted, and embossed brass tube for gaseliers, bedsteads, &c. Forty-eight specimens illustrative of the manufacture of brass and copper wire	20	11	5

	£	s.	d.
Nineteen plates of coloured glass, with names of colouring oxides painted or engraved with hydrofluoric acid upon them, showing the three varieties of coloured glass,—pot metal, flashed glass, and stained glass	2	0	0
Ornamental glass (one landscape, after Claude)	5	0	0
One crown disc - 3″ 1st quality One heavy flint disc - 3″ 2nd „ One crown disc - 2″ 1st „ One heavy flint disc - 2″ 1st „ One crown disc - 1″ 1st „ One heavy flint disc - 1″ 1st „ One crown prism - 2½″ - One light flint - - - } optical glasses	0	19	4
One small annular lens, 5th order, with one ring only, to illustrate the construction of compound annular lenses of dioptric revolving lights	0	10	0
One small cylindrical panel, 5th order, with two rings above and below the central lens, mounted in brass frame, to illustrate the principle of the central lenses of fixed dioptric lights	1	0	0
One prism catadioptric, No. 3, of a 5th order fixed light, in one piece, illustrating the construction of the catadioptric portion of lenticular lights	2	0	0
Sheet of metal for teapot body; sheet of metal turned up for ditto; ditto hammered into teapot body; foot of teapot before stamping; two sides of spout before stamping; two sides of handle before stamping; two sides of spout stamped; two sides of handle stamped; knob before soldering together; the joint of borer, and ivory division of handle; the ring of mouth; the ring of foot	1	17	6
A finished teapot, plain	2	12	0
A finished teapot, embossed or chased. Beautiful specimen	3	7	0
A finished teapot, engraved two styles	3	4	0
Five burnishing tools	0	6	6
Six engraving tools	0	4	0
Five cast pieces of flower stands. Beautiful specimens of casting	0	4	6
Finished flower stand	1	2	0
Eleven chasing or embossing tools	0	11	6
Four steel dies, for stamping	3	13	6
One table-spoon, blank, after first blow Ditto ditto second blow Ditto ditto third blow	0	3	0
One finished table spoon, king's pattern	0	6	0
Materials for the preparation of rare chemical substances	9	6	10
Round glass shades for containing specimens	8	7	1
One large vase and two pillars of blue Derbyshire fluor spar	2	10	0
Cup, saucer, and cream-jug of old Mayence Höchst porcelain	0	10	0
Two round antique dishes. Earthenware of Nevers	1	0	0
Teapot and vase of old crescent-marked Worcester porcelain	2	0	0
Specimen of perforated glass	0	2	6
Glass sample stands	10	12	0
Mountings for looms, &c.	2	11	6
Brass stands for specimens	1	7	0
20 specimens of minerals	3	0	0
One specimen of Loughrow petrifaction	0	7	0
One sheet of rolled Britannia metal. Blank sheet for spinning cream jug. Jug with embossed ornament. Plain cast ewer, illustrative of the production of Britannia metal ware by casting in one piece in piece moulds. Candlestick cast in ditto. Four specimens of transferred engraving, and three of transferred embossed ornaments, made by Sturges' patent process. Specimens of spoons of a particular alloy, called Aluminium spoons. Soft solder. Ingot of soft solder. Sheet of rolled ditto for the manufacture of teapots, &c	3	16	6

Appendix C.

REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

	£	s.	d.
One vase of Berlin iron casting - - - - - -	2	0	0
Glass sample stands - - - - - -	21	2	6
Two educational mieroscopes - - - - - -	25	13	0

In reference to the above list it is proper to remark, that the sums paid for the specimens from Messrs. Elkington and Mason, Messrs. Winfield and Co., Messrs. Chance, Brothers, Messrs. Osler and Co., and Mr. R. F. Sturges, are, in most cases, merely the cost of the raw material employed and form but a very small part of the value of the specimens obtained, which consequently might properly be regarded rather as donations than as purchases from those eminent manufacturers.—R. KANE.

APPENDIX (D.)

THE ADDRESS of HIS EXCELLENCY the LORD LIEUTENANT on DISTRIBUTING the PRIZES, was as follows :—

Sir Robert Kane, my Lords, Ladies, and Gentlemen,—Though certainly not wholly a stranger to these walls, and not quite unconcerned, as you have been just informed by the able director, with regard to the proceedings of the institution, yet this is the first time I have had the pleasure of paying what may be called a formal or official visit to it; and I am most happy to have been able to do so on an occasion when I find it so well filled with more than its usual animate contents, and when the proceedings have been so highly interesting, and of so suggestive a character. If I rightly appreciate the main scope and object of this institution, as well as of kindred undertakings both in this metropolis and the metropolis of the empire, I conceive that the aim and object is to bring down, if I may so express myself, the matters of science and art from that very exalted level, and out of that jealous seclusion, where they are apt to escape popular apprehension at large, amongst the cloisters of old academies, or in the closets of solitary students, and apply them to the common uses of our daily life. It is almost like what we read of in one of the scenes of our great dramatist, where the statue is called down from the niche where it stood before, silent, cold, and unobserved, and made to mix with the warm greetings and brisk intercourse of the crowd around it.

We have heard much in our time of the value which is justly attached to the knowledge of common things. Now, I take it to be the province of the collections which are ranged within those walls, and of the lectures which are delivered amongst you, at once to raise up common things to the dignified part which they may play in the economy of nature, and at the same time to bring the uncommon things of the world, the mysterious resources and concealed treasures of nature, down to the daily ministration to human wants and comforts. Enough has already been collected under this roof—though I hope to see that collection receive constant and large accessions—but enough has been collected to show that nature, or, more properly so to say, the Author of nature, has with no niggardly hand endowed this country with the resources and appliances of art, industry, and wealth—blessed it with a generous soil, with capacious rivers, with matchless harbours, with materials for fuel, with many mineral productions, with quarries of granite and marble capable of furnishing an unlimited supply for any purpose; compare these resources and capability, for instance, with the barren and parched soil of Attica, which has left undying traces amid the annals of our race. Well, then, for the Athenians, we must look, my young friends to you, to whichever sex you may belong. I am happy to find you are not exclusive in the award of your prizes; and, whatever opinion we may hold concerning the rights of women, we are very well disposed to appreciate and acknowledge the merits of women. I hope it will be the object and ambition of one and all amongst you to rise up to the level of those physical advantages by which you are surrounded—of those opportunities and facilities for information and progress which are here so liberally supplied to you—and to the level, let me add, of your own capabilities. You possess a rich and racy soil; and the Irish mind is also amply giving indications that it is neither sluggish, nor cold, nor dead to lively impulses and generous emotions. Let me then entreat you by your diligence, and zeal, and perseverance, to get the best return which you can derive from the exertions of the accomplished director of

this institution, and from the instruction of the able and eminent lecturers whose courses you have attended; and so let every annual recurrence of such a meeting as it has been our happiness to assist at to-night be always a new source of satisfaction with the past, and of hope for the future.

LIST (E.)

Examination in Geology.—Session of 1855–56.

Examiner, J. Beete Jukes, A.M., F.R.S.

Prizes.

1st. William Plunkett.
2nd. Charles W. Bateman.
3rd. Edwin Birchall.

Examination in Chemistry.—Session of 1855–56.

Examiner, William K. Sullivan, Ph. D.

Prizes.

1st. Matthew Higgins.
2nd. John Dowling.
3rd. Henry Slingsby Bethell.

Examination in Physical Science.—Session of 1855–56.

Examiner, William Barker, M.D., M.R.I.A.

Prizes.

1st. Charles W. Bateman.
2nd. J. Mann.
3rd. George Banon.

Examination in Natural History.—Session of 1855–56.

Examiner, John R. Kinahan, A.B., T.C.D.

Prizes.

1st. Miss Halgena Hare.
2nd. William Plunkett.
3rd. Miss F. E. Armstrong.

General Examination in Physical Science, Chemistry, Natural History, and Geology.—Session of 1855–56.

Examiners:

J. Beete Jukes, A.M., F.R.S. | William Barker, M.D., M.R.I.A.
William K. Sullivan, Ph. D. | John R. Kinahan, A.B., T.C.D.

Prizes.

1st. William Plunkett, 46, North Strand.
2nd. James Glennon, 5, Lower Sheriff Street.
3rd. Christopher Murray, 17, Chamber Street.
4th. John Dowling, 13, Victoria Place.

Examination in Geology.—Session of 1856–57.

Examiner, J. Beete Jukes, A.M., F.R.S.

Total number of marks, 1,000.

Prizes.

1st Prize.—1. D. McCready.
2nd Prize.—2. Miss F. E. Armstrong.
3rd Prize.—3. Miss Halgena Hare.

Examination in Chemistry.—Session of 1856–57.

Examiner, William K. Sullivan, Ph. D.

Total number of marks, 1,000.

Prizes.

1st Prize.—1. John Mulligan.
2nd Prize.—2. M. P. Dowling.
3rd Prize.—3. Miss K. H. Egan.

Appendix C.

REPORT OF DIRECTOR OF MUSEUM OF IRISH INDUSTRY.

LIST (F.)

EXAMINATION in GEOLOGY, February 1856.

By J. BEETE JUKES, M.A., F.R.S.

1. What is the difference between a "mineral" and a "rock"?

2. Mention the principal substances which combine to form the following minerals:—*a*, calcite; *b*, gypsum; *c*, hornblende, *d*, mica; *e*, felspar.

3. In a crystalline rock, what should you infer as to its original state from the fact of the minerals having formed crystals in it?

4. What minerals enter into the composition of granite? and what was its original state?

5. What mineral is that, some variety of which is invariably found as a constituent of igneous rocks?

6. Describe, generally, the composition of the following rocks:—trachyte, basalt, greenstone, felstone, syenite, sandstone, marl, limestone, coal, clay-slate, gneiss.

7. State, briefly, what is meant by the following terms:—lamination, stratification, joints, cleavage, dip, strike, fault.

8. What is the difference between a "bed" and a "vein"?

9. In inclined faults, what is the rule as to the relation between the "upthrow" or "downthrow," and the "hade," or inclination of the fault?

10. What is meant by "denudation"?

11. What is "unconformability"? and what general inference do you draw, as to the age of the rocks, from the fact of one group of rocks being uncomfortable to another?

12. If we divide the animal kingdom into the four sub-kingdoms vertebrata, mollusca, articulata, and radiata, which of them are of *most* use to the geologist, and why?

13. What is the reason of the practical importance of fossils, or organic remains, to the geologist?

14. Mention the three great divisions of the series of stratified rocks.

15. The stratified rocks being arranged according to the periods in which they were formed, mention the periods in which the following stratified groups were formed:—

a. Wenlock shale and limestone.
b. The millstone grit.
c. The Oxford clay.
d. The greensand.
e. The London clay.

16. To what class of the animal kingdom did trilobites belong? and in what part of the stratified series are their remains found?

17. To what class do the following fossils belong, and in what part of the series are their remains found, viz.:—Orthoceras, Goniatite, Ammonite, Belemnite?

18. Give the same information as above for the Ichthyosaurus, Plesiosaurus, and Pterodactyle.

19. Name the rocks of which the following fossils are characteristic:—

Graptolites, Cephalaspis Lyelii, Producta gigantea, Spirifer striatus, Terebratula hastata, Gryphœa incurva, Ananchytes ovatus, Pectunculus decussatus, Cardita senilis.

20. What kind of fossil shells are found in the pleistocene marls of the south-east of Ireland? and what are the inferences you draw from their occurrence

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EXAMINATION in CHEMISTRY, February 1856.

By W. K. SULLIVAN, Ph.D.

1. Explain the difference between simple and compound forms in crystals.

2. Define what is meant by a crystalline system, and state how many such systems are recognised.

3. Explain by symbols the changes which take place when dilute sulphuric acid is poured upon metallic zinc.

4. Explain by symbols the changes which take place in the preparation of chlorine from black oxide of manganese, common salt, and sulphuric acid.

5. When nitric acid is poured upon metallic copper, what is the series of changes which results?

6. What quantity of oxygen, by weight and by volume, ought to be obtained by heating to complete decomposition one ounce of chlorate of potash (CLO_5, KO)?

Equivalent of oxygen, =8
„ chlorine, =35·47
„ potassium, =39
100 cubic inches of oxygen, weighing 34·60 grains
1 oz. =480 grains.

7. What quantity of oil of vitriol and water would be required to decompose 1 cwt. of nitrate of potash, so as to produce bi-sulphate of potash and nitric acid of the formula $NO_5 + 3\ HO$; and also the weight of nitric acid and bi-sulphate of potash obtained?

Equivalent of HO, = 9
„ $SO_3\ HO$, = 49
„ NO_5, = 54
„ Nitrate of potash (KO, NO_5), = 101

8. What is the law of combination by volume, where equal volumes of the combining gases unite, and the exceptions to the law; and also the law where unequal volumes combine?

9. What is the predominant chemical character of the compounds formed by oxygen with the non-metallic elementary bodies?

10. What are the usual characteristic chemical properties of the metallic oxides of the formulæ—

$R\ O$
$R_2\ O_3$
$R\ O_2$
$R_3\ O_4$
$R\ O_3$

11. Define what is a base, an acid, and a salt, according to the binary theory; and also the different classes of salts whose existence is now established.

12. Explain the composition of salts and of hydrated acids according to the radical theory—that is, upon the view that all acids are hydrogen acids, like HCl.

13. Explain by symbols the manner in which chlorine acts as an oxodizing agent upon proto-salts of iron.

14. Explain what is meant by the terms allotropism, isomorphism, and isomerism, and specify some of the most remarkable examples of allotropism.

15. State the law of electrolysis or electro-chemical decomposition.

16. What is specific heat, and what relation have the specific heats of bodies with their equivalents, according to Dulong and Regnault, and according to Garnier?

17. What relation exists between the specific gravity of a gas and its equivalent; and the connexion between this relation and the atomic theory?

18. Write the following empiric formulæ of the three alcohols in accordance with the radical theory of organic compounds—

Wood Spirit, $C_2\ H_4\ O_2$.
Alcohol, $C_4\ H_6\ O_2$.
Amylic Alcohol, $C_{10}\ H_{12}\ O_2$.

19. Explain the derivation from ammonia of amidogen, imodogen, nitrile, and ammonium bases, and name some other compounds which may be considered as representing derivatives by substitution from ammonia, according to the theory of chemical types established by Laurent.

20. Define what is a nucleus, and also the difference between a primitive and derivative nucleus, according to the theory of Laurent.

EXAMINATIONS IN PHYSICAL SCIENCE.

Examiner, W. BARKER, M.D., M.R.I.A.

Mention the principal general properties of matter.

What is meant by porosity?

What is inertia? and illustrate it by examples.

On what does the form of aggregation of matter seem to depend?

Mention in order the tenacity of the principal metals.

State the general laws of expansion by heat applied to solids, liquids, and gases.

State any exceptions to these laws.

Give some examples of the practical application of these laws.

State the order of conductive power for heat of the following substances:—water, air, mercury, iron, silver, copper, lead, glass, porcelain, and wood.

What is the meaning of the terms temperature of a body, and capacity for heat of a body?

What change does water undergo when converted into steam?

What are the economic objections to Newcomen's and Savery's steam engines?

State the improvements introduced by James Watt into the steam engine, and the principles applied by him.

How is the existence of latent heat in steam shown?

What are the different theories respecting the origin and nature of electricity?

What is the principle applied in electrotyping?

How should lightning conductors be applied to protect buildings?

What do you mean by the resultant of two or more forces? and how is it ascertained?

Two weights, one equal to 6lbs., the other to 15lbs., are applied to the ends of an uniform rod weighing 3lbs., and 6 feet long, what force must be applied to the rod to produce equilibrium? and in what point of the rod?

What are the principles of the three kinds of lever?

How is an inclined plane considered a machine?

Why are the surfaces of liquids horizontal?

Explain the principle of the barometer.

Whence are derived the forces in water and air when used as prime movers?

Examination in Natural History, May 1856.

By John R. Kinahan, A.B., T.C.D.

1. Define *Primordial utricle* according to Mohl.
2. What is meant by *free cell* formation?
3. What other forms of cell formation have been described?
4. What is meant by the *Cotyledon, Plumule, Caulicle, Radicle,* in the seed? What analogues do we meet to these several organs in the fully developed plant?
5. Define *Cellulares, Vasculares,* giving examples.
6. Explain the terms *Cryptogamia, Phanerogamia—Eterorhizal, Endorhizal, Exorhizal.* Giving examples of each.
7. What is the true botanical signification of the *tuber* of *Dahlia* and *Solanum*? —State your reasons for this opinion.
8. State in brief the essential differences between the Acrogenous Endogenous, Exogenous stems, giving examples of each division
9. What is meant by term *spadix*? give an example.
10. Describe the following in brief—Spike, Corymb, Panicle, Capitulum—Follicle, Capsule, Siliqua, Legume, giving examples.
11. Give the essential characters of the following natural families—Ranunculaceæ, Rosaceæ, Cruciferæ, Graminceæ.
12. Refer to its proper natural family, a plant answering the following description. Leaves alternate; sepals 5 permanent; petals 5–10; stamens indefinite hypogynous; carpels 2-3 many seeded. Fruit two valved, opening by its inner face.

State the anomaly in the above description.

13. On what system did Cuvier found his four great divisions of the animal kingdom?
14. What objection is there to his system?
15. Give short definitions and examples of the classes *Vertebrata, Mollusca, Articulata, Nematoneura, Protozoa.*
16. What is th carrangement of the heart in the five primary divisions of the Vertebrata?
17. Give an instance of an anomalous order among the monodelphic Mammals; stating the most striking exceptions to the normal condition found in it.

18. What is meant by alternation of generation in *animals* and in *plants?* Give examples, and state most striking peculiarities in phenomena exhibited by each.

12. State the most striking differences between plants and animals, and the most striking analogies met with in each class.

20. Describe the specimens on the table.

GENERAL EXAMINATION, May 1856.

Geology.—By J. Beete Jukes, A.M., F.R.S.

1. What is meant by geology? and what is the difference between geology and mineralogy?

2. What are the two principal kinds of rocks and their origin?

3. Mention some of the more common varieties of each of the two great classes of rock.

4. What is meant by palæontology?

5. Explain as far as you can the connection between palæontology and physical geology.

6. What was the origin of coal, and what are the fossils most characteristic of the coal measures?

7. Write out in the order of their occurrence the series of stratified rocks which are called primary or palæozoic.

8. Mention any fossils which occur to you that are characteristic of the lias.

9. Explain the terms "fault," "denudation," and "unconformability."

10. What is a mineral vein? how does it differ from a "bed?" and what are the relations between "mineral veins" and "faults"?

11. What do you mean by a "Volcano?" and to what source do you attribute its igneous action?

12. Of the rocks which form the surface of Ireland, which are most abundant—those which lie below the coal measures, or those which lie above them?

Natural Philosophy.—By W. Barker, M.D., M.R.I.A.

What is the latent heat of steam, and how is it calculated?

Give the rates of expansion for water, mercury, alcohol.

Does the density of all fluids increase with diminished temperature?

Explain the theory of the Leyden jar.

What is an electrophorus? and explain its theory.

Explain the action of an electrifying machine by the theories of Franklin and Dufay.

Why does the middle point of a magnet show no evidence of being magnetic?

Prove in a system of two parallel forces the amount and position of the resultant.

State the relations of time, space, and velocity of falling bodies.

How is the momentum of a body calculated?

What is a machine, and on what does its utility depend?

Explain the hydrostatic paradox.

Chemistry.—By William K. Sullivan, Ph. D.

1. State the chief laws according to which bodies combine by weight.

2. State the four laws relating to combination by volume, namely: (1.) Gay Lussac's law of combination by volume; (2.) the law of gaseous dilatation; (3.) the law of the specific heat of the gases; (4.) the relation between the atomic weight and specific gravity of gases.

3. Write the formulæ of all the compounds of oxygen with nitrogen—state the proportions by *weight* and by *volume* of the two constituent gases, in each compound; and what relation the volumes of the compound gases produced in each case bear to the volume of their constituents.

4. What relation does the volume of the vapour of water bear to the volumes of the constituent gases of which it is composed? and what ought to be the specific gravity of steam? that of oxygen being 1·1056, and that of hydrogen being 0·0692.

5. Given 1 cwt. weight of sulphur to find how much oil of vitriol can be made from it; how much salt that quantity of oil of vitriol will decompose so as to produce neutral sulphate of soda; what quantity of chlorine by weight and by volume can be obtained from the muriatic acid set free by the decomposition of

Appendix C. — Report of Director of Museum of Irish Industry.

the salt; and lastly, how much bleaching powder can be obtained, theoretically, by the absorption of that quantity of chlorine.

Equivalent of sulphur	- - - - -	16.
„ oil of vitriol	- - - - -	49.
„ common salt	- - - - -	58·47.
„ chlorine	- - - - -	35·47.
„ sulphate of soda	- -	71·0.
„ bleaching powder = Ca O, Cl O + Ca Cl	- -	126·94.
100 cubic inches of chlorine	=	76·59 grains.

6. Mention what classes of salts are included under the term *amphigenic salts*, and point out the analogies by which these different classes are grouped together.

7. What are *halogenic* or *haloid* salts according to the binary theory? and what according to the radical theory?

8. What is meant by the terms *basic*, *neutral*, and *acid salts?* and what is the relation between the oxygen of the base and the oxygen of the acid in each?

9. Explain the difference between the salts of bi-basic and poly-basic acids and ordinary acid salts; and explain the constitution of a poly-basic acid, such as phosphoric acid, according to the radical theory.

10. Explain the difference between *basic* or *constitutional* water and water of crystallization.

11. What is the meaning of the terms simple elective affinity and double elective affinity?

19. What is the action of sulphuretted hydrogen upon soluble salts of the metallic oxides? how far may this reaction be made the basis of a classification of metals for the purposes of analysis?

Natural History.—By John Robert Kinahan, A.B., T.C.D.

Botany.

1. What is meant by *Exosmosis* and *Endosmosis*?—What conditions are essential to the existence of the phenomenon?

2. Give the botanical explanation of the *bulbs* of the Lily, Onion, and Crocus:—Give an example to prove this view.

3. Explain the following—*Axile placentation, Parietal placentation.*

4. Two theories have been proposed to explain *Free central placentation*—state them.

5. What is meant by the respiration of plants?—state some of the theories on this subject.

6. Contrast the position of parts in *orthotropal* and *anatropal* ovules.

Zoology.

1. State some of the most striking peculiarities of structure in the Reptilia as contrasted with other Vertebrata.

2. The Batrachia, formerly classed among the Reptilia, have been now separated, and why?—State chief distinctions between classes.

3. What are the differences distinguishing true Metamorphosis and the Phenomena classed under alteration of generations?

4. Give examples of Metamorphosis from among the Vertebrata and Articulata, stating the stages passed through in each family.

5. The class Cirrhipedia has been removed from the family Mollusca of Cuvier, where is it now placed? and what has led to the change?

6. The Animal Kingdom being divided into the following families, Vertebrata, Mollusca, Articulata, Nematoneura, Protozoa; refer to their proper families and classes the following, stating characters which lead to your opinion:—

Delphinus delphis (Dolphin).
Holuthuria cucumis (Sea slug).
Balanus anatifa (Barnacle).
Musca domestica (Housefly).
Rana temporaria (Common frog).

Annual Report of the Royal Dublin Society for the Year 1856.

To the Right Honourable Lord Stanley of Alderley, President of the Board of Trade.

My Lord,

Appendix C.

Report of Royal Dublin Society.

I have the honour to submit, by direction of the Council, the Annual Report of this Society for the Year ending the 31st December 1856, being the 125th from its formation.

The Council have much gratification in reporting upon the increased prosperity and usefulness of the institution as evinced by an unusually large accession of new members,—71 having been admitted during the session ending in June last,—and by an increase in the numbers of the public who have attended its several departments, numbering 137,401 persons.

With reference to the lectures delivered in the Society's premises by the Professors in the Department of Science and Art, under the direction of the Committee of Lectures, the Council have much pleasure in reporting that they were regularly delivered during the past Session, and attended by large audiences.

The Committee of Lectures duly communicated the arrangements for the delivery of lectures in the Society's premises during the current Session, which, as forming an essential portion of the course of public instruction now being carried into effect, through the medium of this Society and of the Museum of Irish Industry, meet with the warm approval of the Council.

The Council are further gratified by observing that means have been adopted for awarding prizes to students, whose proficiency has been tested by Examinations held at the terminations of the several courses of lectures delivered in both institutions,—a practice instituted by this Society as regards both their Scientific and Technological Lectures, at so early a period as the year 1796.

The Council are much pleased that the restriction which prevented members of the Society from attending certain courses of lectures in the Museum of Irish Industry, unless paid for, has, on representation to the Board of Trade been removed. The members have consequently the privilege of attending, free of charge, all the courses delivered in that institution.

Within the past Session, the Council, with the sanction of the Society, issued for the first time "The Journal of the Royal Dublin Society," three numbers of which have now been published. The Council consider the publication of this periodical to be of great importance to the institution, inasmuch as in its pages will be found a public record of its proceedings, as regards the advancement of those arts and sciences for the promotion of which the Society was incorporated. As the record of the Scientific and Educational Departments, it will be found to awaken a degree of interest therein which cannot fail to aid their extension; while from

its being the medium of publication of those communications on the natural and applied sciences made to the Society from time to time, the reputation of the institution will be enhanced. The Council, impressed with these convictions, have urged upon the Society the advisability of its working out this project with energy, especially, sanctioning a liberal use of illustrations, by lithography and other means, of the papers that may from time to time be published in its pages.

In addition to the large number of donations presented by private individuals to the several collections of the Society, the Council have much gratification in reporting that it has been selected during the past year by departments of Government as the depository of the following important works: viz., —

Copy No. 8. of the Standards of Weight and Length, presented for the City of Dublin by his Excellency the Lord Lieutenant.

A Copy of the Specifications of Patents, and Indexes of Patents, presented for the City of Dublin by the Commissioners.

And a Set of Photographs of the Paris Universal Exhibition, presented by the British Commissioners.

The Council beg leave to submit the following Reports on the several Departments of the Society.

Botany and Horticulture.

Lectures.

John R. Kinahan, M.B., Acting Professor of Natural History in the Department of Science and Art, as deputy of Doctor Harvey, who was then absent, delivered one course of twelve lectures on Structural and Physiological Botany in the Theatre of the Society, attended by 807 persons, averaging 67 at each lecture; and one course on Systematic Botany, at the Botanic Garden, Glasnevin, attended by 327 persons, the daily average being 27.*

Botanic Gardens.

With reference to this department, the Council have much pleasure in submitting the following satisfactory report of the Curator: —

"My Lords and Gentlemen,

"I have the honour to submit to you my Annual Report on your Botanic Garden for the current year, which in the present instance will be brief, as little has occurred connected with this department requiring special notice since last December.

"1. *Buildings and Repairs.*—Under this head I have to report that the whole of the conservatories, plant-pits, and frames, were painted during the past summer, and all broken glass repaired, whereby they were placed in good condition, in which state they

* In last year's Report it was erroneously stated that Dr. Allman delivered six lectures at the Botanic Gardens, the number delivered having been 12, and the average daily attendance 68.

continue to be up to the present time. A small house has lately been constructed out of the best of the materials of the old orchid and fern houses, which were removed some time ago. It has been placed at the back of the principal range, and is intended for the cultivation of some hardy ferns, which cannot well be grown along with the general collection, such as *Trichomanes Speciosum, Hymenophyllum Tunbridgense, &c.*, and also for the propagation of Australian and South African plants.

"2. *Collections and Donations.*—The new Conservatory, which was recently built by the aid of Parliament, and with the sanction of the Board of Trade, forming the right wing of the proposed new range, was filled with the plants intended for it early in the year, and I am now able to state the results have hitherto been satisfactory, as are manifest by the healthy appearance of the plants.

"Considerable accessions of both hardy and tender plants (new to this collection) have been made during the year. The Committee, with the approbation of the Council, directed me to visit the principal botanical and horticultural establishments in Belgium, Switzerland, and parts of Germany and Italy, for the purpose of effecting exchanges in plants, and obtaining information on matters connected with this department. I accomplished the journey last September, and it now affords me pleasure to report I was well received at those institutions, where I found a ready disposition on the part of the principals to exchange plants whenever I desired it. At Ghent some valuable specimens were obtained from the very extensive and far-famed collection of M. Louis Van Houtte also from the fine collection of M. Van Geert, some good Palms and Orchids were procured. From the Royal Botanic Garden at Berlin, M. Bouché sent seventy-three species of exotic Ferns, most of which were additions to these in this collection: and from the Botanic Garden at Zurich upwards of two hundred and fifty species of rare Alpine and other plants were obtained, through the kindness of M. Ortgies.

"Among the latter were eighty-five species of Cacti, belonging to the genera *Mammillaria* and *Echinocactus*, seventy of which were new to this garden. These donations, with many others of less importance, were duly reported as they arrived, and I need not therefore dwell on them now at length, in this general Report, especially as I intend to furnish a more detailed note of the journey before long.

"In England I experienced in nearly every instance that degree of liberality and kindness which I have always found when visiting the botanic gardens and principal nurseries. Mr. Marnock, of the Royal Botanic Garden, Regent's Park; Mr. Moore, of the Botanic Garden, Chelsea; Mr. Henderson, of the Pine Apple Place Nursery; and Mr. Low, of the Clapton Nursery; severally sent all the plants I selected from their respective establishments. From Mr. Veitch, of the Exotic Nursery, King's Road, Chelsea, I obtained a Plant of great botanical interest, and of considerable value, namely, 'the Water Yam,' *Ouvirandra fenestralis*, which has very recently been introduced to Europe.

"This remarkable plant is a native of the Island of Madagascar, where it grows on borders of running streams, attaching itself to their banks by means of its rhizome-like roots. The leaves have no skin (or parenchyma), but consist of a network of veins in meshes of a quadrangular form, of great beauty when viewed as they float in the water.

"In the early part of the year, another plant of much importance was received from Mr. Baxter, of the Oxford Botanic Garden, namely, that which produces the substance from which the Chinese manufacture the delicate and beautiful tissue called Rice Paper, *Aralia papyrifera.* It is only within the last few years the true plant became known to Europeans, and this is the first living specimen which reached Ireland. It is singular how long the origin of some substances of great commercial value remain unknown to us; for example, the Cuban Bast has of late years been extensively used for gardening and other purposes, in place of the Russian Bast, yet no one in Britain appears to have known the plant which furnished it until the present year, when Sir W. Hooker ascertained it was the inner bark of *Hibiscus elatus.* A living plant of this along with some other rare species was sent from the Royal Botanic Garden, Edinburgh, last November.

"*The total* number of *plants* received during the year is 641 *species*, and of *seeds* 849 *papers.*

"From the garden 483 *species of plants* have been distributed, and 55 *papers of seeds.*

"3. *Donations, &c. to Museum.*—Some valuable donations have been made to the Museum, which is becoming of increasing interest to visitors. Your active and obliging members, R. A. Reilly, Esq., and W. H. March, Esq., have lately sent a valuable collection of specimens of the principal kinds of Woods which grow in the Island of Jamaica, along with some of the more remarkable kinds of fruits and seeds of plants: since their arrival the former have been cut to proper lengths, both in transverse and longitudinal sections and properly polished; but at present no means exist by which this fine series can be exhibited, the few glazed cases originally provided being already filled with other articles. The committee will, therefore, require to consider how this collection can best be displayed before the public can profit from the donation.

"A beginning has been made to collect examples of plants as they appear when attacked by insects, along with the insects which destroy them. Subjects of this nature will, I trust, ere long furnish one of the most important and instructive departments of this Museum. It would be my desire, if proper accommodation were provided, to collect as many examples of this kind as could be procured, foreign as well as native, but especially the latter, which, along with plants attacked by the more destructive kinds of fungi, might form a pathological collection, by which the diseases of plants could to a considerable extent be illustrated. It is now well known that insects and parasitical fungi produce, by their

separate and combined attacks, the diseases which are vulgarly known as *blights* on vegetables, about which very little rational information appears to be diffused, particularly among the class of persons who have to combat against them.

"A good series of examples, such as here contemplated, would, I conceive, be calculated to remove many existing errors, as well as to afford means to reason correctly on these matters.

"4. *Experiments with Manures, &c.*—According to instructions received from the Council last spring, I placed myself in communication with the professor of agricultural chemistry, for the purpose of affording him assistance in testing some artificial manures he wished tried. Professor Davy attended at the garden and superintended the experiments. The different ingredients were duly weighed, and applied to measured compartments of ground, on which seeds of various crops were afterwards sown; some of those, owing to causes I cannot explain, failed in the first instance, and had to be re-sown, which threw the crops later than the others where the first sowings succeeded, thus preventing a fair comparison from being made. We have, therefore, considered it advisable to refrain from making any further report on this subject at present.

"5. *Experiments on Vegetables.*—After the experience of another year in the cultivation of the Chinese Yam, *Dioscorea batatas*, and Sugar Grass, *Holcus saccharatus*, I have not a more favourable report to make concerning them than that which I furnished last year. They are not suited for the climate of Ireland to grow as profitable crops. The spring frosts destroy them when too early planted out, and our short, cool summers do not enable them to perfect their growth before they are destroyed by the frosts in autumn.

"A new variety of Borecole, called Tramanda cabbage, has been cultivated in the vegetable department, and promises to be a good sort. The leaves have silvery-white veins, resembling those of the silver beet, and do not grow so close as to become hard in the centre like most kinds of cabbage; besides, their substance is tender and sweet when boiled. His Grace the Archbishop of Dublin presented the seeds from which the plants were raised.

"6. *Supplies of Plants and Specimens for Botanical Lectures and to the School of Art*—As usual, the School of Art at the Royal Dublin Society, and Model Lace School, Harcourt Street, have been regularly supplied twice every week with plants and flowers. To the former upwards of 1,600 examples have been sent during the year, and to the latter 1,200; the same kinds having been of course frequently repeated in this calculation.

"Specimens of plants and flowers were also sent, according as they were called for, to illustrate the lectures on botany delivered at the Royal Dublin Society, as well as those at the Museum of Irish Industry, Stephen's Green. The Professors of Botany to the Royal College of Surgeons and to the Carmichael School of Medicine have been furnished with supplies of specimens for their lectures, as they required them, and every facility has been afforded, when visiting the gardens with their pupils, for studying the living

Appendix C. — Report of Royal Dublin Society.

plants in their respective classes, which they generally did once a week during the summer months.

"It hardly comes within the scope of this Report to make any observations respecting the pecuniary arrangements it has been considered advisable to adopt in reference to this department; yet I may be excused for respectfully stating my opinion, that making a charge for the admission of the public on certain days of the week does not work well. The proceeds arising from this source do not average more than about 30*l.* or 35*l.* yearly, the collection of which is attended with great inconvenience on our part, and paid with reluctance by the public.

"The gatekeeper has informed me that as many as 200 or 300 persons have occasionally left the gate on some of the days they were refused free admission. I would therefore suggest that this matter may be reconsidered.

"7. *Number of Visitors.*—The number of persons who have visited the gardens during the year has been 32,900.

(Signed) "D. Moore,
"*Curator.*"

A list of donations received at the Gardens during the past year will be found in the List (A).

Natural History.

Lectures.

John R. Kinahan, M.B., delivered a course of twelve lectures on zoology, in the month of November, attended by an average daily audience of 127, the total amounting to 1,524 persons.

In the month of January, John Scouler, M.D., the Society's Professor of Mineralogy and Geology, delivered four lectures on mineralogy, which 170 persons attended, or 43 at each lecture. In consequence of the severe illness of Dr. Scouler, he was compelled to discontinue the course, since which he has not been able to resume his duties.

J. Beete Jukes, A.M., F.R.S., Professor of Geology in the Department of Science and Art, delivered a course of twelve lectures in the month of March, on geology, which was attended by 4,521 persons, averaging 392 at each lecture; and in the month of December a course of twelve lectures on physical geography, attended by 156 persons at each lecture, or by a total of 1,881.

Museum of Natural History.

The Director of the Museum of Natural History continues to be unremittingly engaged in identifying, and naming, the specimens, preparatory to their removal to the new building, the foundation stone of which was laid by his Excellency the Earl of Carlisle, Lord Lieutenant of Ireland, President of the Society, in presence of a large number of spectators, on the 7th April, and which is now considerably advanced towards completion. Although the greatest economy has been observed in its construction, yet in consequence of the buildings being more ornamented than that originally intended, by its being erected upon the lawn of the Society instead of the agricultural premises, a change of site which

the Act of Parliament for the erection of a National Gallery and Public Museum in Dublin rendered necessary, it will be impossible to complete the building with the means at the disposal of the Society for this object. The Council have, therefore, been reluctantly compelled to apply to the Board of Trade to recommend the Treasury to include a further sum in the estimate of the Society to be laid before Parliament to enable it to complete this work.

The Council beg to submit the annexed Report of the Director of the Museum.

"My Lords and Gentlemen,

"Since I had the honour of submitting my last Report, I have to congratulate you on the rapid progress made towards completing the new Museum, which is now being roofed in.

"Some time must necessarily elapse before it can be sufficiently dry for the reception of the collections, and as the rooms at present devoted to the Museum are completely filled, I am consequently unable to report any addition to or further progress made in the systematic arrangement of the specimens, from want of accommodation.

"Nevertheless, during the past year considerable progress has been made in setting up and correctly naming, according to the present advanced state of the science, not only the specimens formerly in your collections, but also those which are being constantly added, so that when the new building shall be ready for their reception, the time that should necessarily be spent in such labour will be much abridged.

"You will perceive by the accompanying returns that many very valuable and highly interesting donations have been received during the year, and as heretofore, the collections have been extensively used by the Professor of Natural History for the illustration of his public lectures, which rendered them both practically useful and highly attractive.

(Signed) "A. Carte,
"*Director.*"

A list of the donations will be found in the List (B).

Chemistry.

Lectures.

In April W. K. Sullivan, Ph. D., delivered a course of 12 lectures on chemistry in the Society's Theatre, at which 832 persons attended, the daily average being 69, and a second course in the month of October, at which 1,716 persons attended, averaging 143 at each lecture.

In the month of June, Edmund Davy, F.R.S., professor of Agricultural Chemistry to the Society, delivered a course of 16 lectures, at which 633 persons attended, averaging 39 at each lecture.

At the conclusion of this course 17 pupils who had paid a small fee for registration were subjected to an examination by means of printed questions on the subjects of the lectures, and prizes were awarded in books and certificates to the most deserving. The

bronze medal of the Department of Science and Art was awarded in addition to the student who obtained the first prize, Mr. F. H. Barreau.

Laboratory.

In the laboratory the following investigations were conducted:—

Miscellaneous experiments on the relative deodorizing power of different substances.

On the use of platina instead of porcelain or glass in Marsh's method of detecting arsenic.

Experiments on new cements.

Examination of fungoid spots or stains on linens returned from the West Indies, with a view to suggest a remedy.

Examination of guanos and clays.

Examination of artificial manures.

Examination of milk and matter ejected from the stomach.

A series of experiments made to determine the comparative value of peat and peat charcoal for agricultural purposes.

Examination of the urine of a patient under treatment with strychnine, for that alkaloid.

Examination of bronze and bronzing fluid.

Examination of a human intestinal concretion.

Examination of urine and vomited fluid.

Examination of the matter of an ovarian tumour.

Examination of fluid from the ventricles of the brain.

Experiments upon a new manure.

Physics.

William Barker, M.D., M.R.I.A., Professor of Physics in the Department of Science and Art, delivered a course of 12 lectures in the Society's Theatre, during the month of February, which was attended by 1,150 persons, averaging 95 at each lecture, and in the month of October a second course of 12 lectures, at which a daily average of 131 persons attended, total 1,572.

The Council have to report, in reference to the maintenance of the Physical apparatus belonging to the Society, that the Director of the Museum of Irish Industry has intimated that the Professor of Physical Science is authorized to have such of the apparatus as he may use for the illustration of his lectures, whether delivered in the Theatre of the Society or in the Museum of Irish Industry, maintained in proper working order out of the funds voted to the Museum of Irish Industry, an arrangement which the Council consider satisfactory.

Evening Meetings.

For the Discussion of Subjects connected with Science and Art.

During the session commencing November 1855 and ending June 1856, eight meetings were held, at which 737 attended, averaging 92 at each meeting.

The following are the subjects of the Papers that were read :—

1855 :—November 30.

Professor Davy :—On the Deodorizing Properties of Peat and Peat Charcoa .

William Edward Steele, M.D. :—On the use of Chloride of Lime as a Preventative of Smut in Wheat.

Professor William Barker, M.D.:—Exhibited experiments with Rhumkorff's electrical coil.

December 28.

Alexander Carte, A.M., M.B. :—A paper on the Egg of the Ivory Gull (Larus eburneus).

Edmund William Davy, M.B. :—On the Comparative Value of Peat and Peat Charcoal for Agricultural Purposes.

Thomas Grubb :—On a Decimal Currency. (First part.)

1856 :—January 25.

Thomas Grubb :—On a Decimal Currency. (Second part.)

Captain F. L. M'Clintock, R.N. :—A Paper on the Distribution of Animal Life in the Arctic Regions.

February 29.

Gilbert Sanders :—On a Method of Preserving a Just Water Level in Gas Metres and Steam Boilers.

March 28.

Dr. Lamprey, 15th Regiment :—On the Physical Character of the Aborigines of Ceylon.

Professor William Barker, M.D. :—On the Standards of Weight and Length recently deposited with the Society.

James Dillon, C.E. :—On a New Instrument for Measuring the Seat of an Embankment in Railway Cuttings.

April 25.

Professor Davy, F.R.S. :—On the Electro-Chemical Method of detecting Arsenic.

J. R. Kinahan, M.B. :—On Australian Crustacea.

William Acheson :—On the Origin, Progress, and Material of Ancient Personal Ornaments.

May 30.

Rev. Professor Haughton :—On Silurian, Carboniferous, and Liassic Fossils collected in the Arctic Regions by Captain M'Clintock.

David Moore :—On Mosses, and other Cryptogamic Plants recently discovered in Ireland.

June 20.

J. R. Kinahan, M.B. :—On the Guano Deposits of the Chinchas, Peru.

Rev. Professor Galbraith :—On the Decimal Currency.

Thomas Tisdall :—On a New Steam Propeller.

Professor Davy :—On a New Method of Printing and Writing on Metals.

Department of the Library.

The Librarian has reported that during the year 1856 the library was open on 297 days, and closed on 14 only. The average number of daily readers, exclusive of members of the Society who are not enumerated, was 32, being a total for the year of 9,494.

The additions to the library since the last yearly return are—

Books presented as donations -	142
Books purchased - - -	314
Total - - -	456

periodicals, 107; and the Parliamentary Papers of both Houses for the past Session.

Appendix C.

Report of Royal Dublin Society.

In addition to this the library has been selected as the depository of the specifications of patented inventions, presented by the Commissioners of the Great Seal Patent Office for the *free use* of the citizens of Dublin, each new specification of patents being forwarded as soon as printed, with all the indexes to patents from the year 1617 to the present day. Great care has been taken in the arrangement and binding of these, so as to preserve them, and at the same time to render them easy of consultation. The plan adopted combines all advantages of those followed in London and Manchester. As the collection is large and increasing rapidly, additional accommodation for it is immediately required.

In the List (C) will be found a list of the donations to the library for the year ending November 14, 1856.

Department of Agriculture.

This important department of the Society continues in a highly satisfactory state. The Agricultural Exhibitions are held in spring and winter, the former demanding an amount of accommodation which the Society experiences no little difficulty in providing. The national importance of the Spring Show can be understood by reference to the following comparative statement of the four principal Shows of Short-horned Breeding Stock, held in the United Kingdom in the Year 1856.

Description Short-horned Breeding Stock.	Royal Dublin Society.	Agricultural Society, England.	Highland Society, Scotland.	Agricultural Society, Ireland.
	April.	July.	August.	August.
Bulls, 1 year	134	10	11	20
„ 2 years	40	14	11	9
„ 3 years	14	18	9	6
„ Aged	14	—	5	1
Total	202	42	36	36
Heifers, 1 year	32	17	12	24
„ 2 and 3 years	23	12	7	18
Milch cows	10	9	22	22
Total cows & heifers	65	38	41	64
Bulls	202	42	36	36
Heifers and cows	65	38	41	64
Total Short-horned Breeding Stock	267	75	77	100

It will be seen by the above abstract that 192 head of Short-horned Breeding Stock were exhibited at the Royal Dublin Society's late Spring Show more than at the Royal Agricultural Society of England, at Chelmsford; 190 head more than were shown at the Highland and Agricultural Society of Scotland, at Inverness; and 167 more than were exhibited at the Show of the

Royal Agricultural Improvement Society of Ireland, at Athlone, or 15 head of similar stock more than were exhibited collectively at the three principal Shows of the United Kingdom, held during the year 1856.

Spring Cattle Show.

This Exhibition was held on Tuesday the 15th April and three following days, and was in every respect eminently successful.

The following Table exhibits some of the Statistics of the Show :—

Description.	Entries or Lots.	Prizes.		
		Money.	Medals.	Certificates.
		£ s. d.		
Bulls	224	31 0 0	13	—
Cows and heifers	114	— —	22	—
Fat stock	18	— —	7	2
Sheep (lots)	70	34 0 0	6	16
Swine (lots)	104	46 0 0	—	6
Horses	39	10 0 0	7	1
Poultry	190	18 0 0	—	—
Implements	267	100 0 0	—	—
	926	239 0 0	55	25

In addition to the prizes above enumerated, the Irish Farmers' Gazette Challenge Plate, valued at 150*l.* (105*l.* of which had been contributed by Mr. Townley, the permanent owner of the former cup), was won for the first time by the Earl of Clancarty, and the Townley Tenant Farmers' Cup was won the third time and permanently by Mr. John Christy, of Adare.

A novel feature of this show consisted in the exhibition of agricultural machines in motion, such being necessary for testing their comparative merits. Although the outlay for carrying this into effect was necessarily very large, yet the acknowledged utility of the experiment justified the Committee of Agriculture in the undertaking; and aided by the Committee of Manufactures, who devoted 100*l.*, for prizes, from their allocation, the result proved eminently successful, the large amount received at the entrance gates being more than sufficient to cover the expenses.

His Excellency the Lord Lieutenant presided at the meeting for the announcement of prizes, at which 350 persons attended.

Winter Show of Fat Stock, Farm and Dairy Produce.

This show was held on Tuesday, December 9th, and two following days.

These exhibitions being held in the open air during the winter season, the Council cannot expect to be even self-supporting, and impressed with this conviction they have taken steps for obtaining subscriptions throughout the country for roofing in the entire of the cattle yard, which they feel assured, when accomplished, will be the means of obtaining more creditable displays of stock, and of attracting a larger attendance of visitors on these occasions.

Appendix C.

REPORT OF ROYAL DUBLIN SOCIETY.

The following are the results of the Show:—

Description.	Entries or Lots.	Prizes. Money. £ s. d.	Medals.	Certificates.
Oxen	5	5 0 0	1	—
Cows	2	3 0 0	1	—
Heifers	43	20 0 0	1	—
Sheep	66	12 0 0	—	3
Swine	21	6 0 0	—	1
Total Fat Stock	137	46 0 0	3	4
Green crops	190	18 0 0	1	16
Cereals, pulse, seeds	112	—	18	—
Butter and honey	13	3 0 0	—	1
Cheese	3	—	2	—
Freize	2	—	2	1
General collections	4	3 0 0	—	1
Flax and hemp fibres	5	1 0 0	—	1
Collections for special prizes	3	2 10 0	—	—
Wools	4	2 0 0	—	—
Total	436	29 10 0	23	20

The following Table exhibits the relative weights of the prize roots grown in Ireland, and of the English grown roots exhibited at the late Show at Birmingham :—

—	Royal Dublin Society's Show.	Birmingham Show.	Difference.
Six prize roots of—	lbs.	lbs.	lbs.
Swede turnips	102	88	14
Long mangels	108	90	18
Red globe	117	104	13
Orange globe	115	None exhibited.	—

12,763 persons attended both Shows of the Society.

Smithfield Club Show, London.

In December the Society exhibited a limited collection of farm produce at the Smithfield Club Show, in London, and, notwithstanding their inferiority to those exhibited at the Society's Show, they attracted the marked attention of the immense concourse of persons who attended that Exhibition.

The idea of exhibiting the farm produce of Ireland in London at these shows originated with his Excellency the Earl of Clarendon, when President of the Society, as Lord Lieutenant of Ireland; and, assured of its great importance in demonstrating to the agriculturists of England the productive nature of the soil of

Ireland, the Society has since continued to exhibit similar collections at these Annual Shows.

International Agricultural Exhibition at Paris, 1856.

At the special invitation of his Excellency the Minister of Agriculture in France, this Society undertook the arrangements for securing a proper representation of the agricultural industry of Ireland at the great International Agricultural Exhibition held in Paris in June 1856. For this object a special committee was appointed by the Society, who were authorized to co-operate with a committee appointed by the Royal Agricultural Improvement Society of Ireland for the same object. Owing to the liberality of the Corporation for Improving the Port of Dublin and of the municipal authorities of Havre, the port dues chargeable on vessels leaving the one and entering the other were removed, and the joint committee were consequently enabled to charter a large steam-vessel, the "Windsor," for conveying the stock from Dublin to Havre direct.

The result of the several arrangements of the committee were most satisfactory; very creditable collections of Irish stock, and of such agricultural produce as could be procured, were forwarded to Paris under the superintendence of Mr. Corrigan, the Curator of the Agricultural Museum of the Society, and *Thirty-one prizes* were awarded to the exhibitors, including a Gold Medal to this Society as an exhibitor of superior samples of flax and grain.

The Society, as the oldest in the United Kingdom for the promotion of agriculture, appreciating the exertions and liberality manifested by His Imperial Majesty the Emperor of the French in advancing the cause of agriculture, appointed a deputation from their body to wait upon and address His Majesty, and at the same time to offer him the honorary membership of the Society, which His Majesty was graciously pleased to accept.

Agricultural Museum.

This department was visited during the past year by 25,370 persons.

The collections of cereals, grasses, and farm seeds are very complete; the principal seedsmen of Dublin contributing samples from time to time, and occasionally extensive collections.

The principal manufacturers of agricultural implements and machines continue to deposit in the Museum their latest inventions, and thus a collection is maintained of great utility to the practical farmer, by inspecting which he is enabled, with the least amount of trouble, to judge of the merits and ascertain the name and address of the maker of any machine he may consider it advisable to procure. Several very valuable machines were deposited with the Society during the past year, in addition to those presented. Of these a steam threshing and winnowing machine, and a dynamometer, are the most worthy of note.

The attendance of the Curator at the principal agricultural exhibitions in England and Ireland, and at the International Cattle Show of Paris, was the means by which several interesting presentations were obtained for the Museum, a list of which is given in List (D).

Appendix C.

Report of Royal Dublin Society.

Department of Manufactures.

Under the head of Agriculture, it is stated that the Committee of Manufactures awarded 100*l.* from their allocation in prizes for agricultural implements and machines exhibited at the Annual Spring Cattle Show, whose merits were ascertained by practical trial. The Committee have also taken steps for having specimens of the works executed in industrial schools permanently exhibited in the Crystal Palace at Sydenham.

Department of Fine Arts.

School of Art.

With reference to this department, the Council are gratified by reporting that the School of Art is likely ere long to become self-supporting, a circumstance which the Council did not anticipate would so soon occur. The Council annex a financial statement of the school for the session ending 30th July, from which it may be observed that its charge upon the Society's funds is now trifling in amount; it is also to be remarked that as several of the expenses charged against the school should necessarily be incurred, even were the school not under the care of the Society, the actual expense is less than that which appears by the accounts (*vide* Table E); an amount which would be diminished by 20*l.*, had the pupil-teachers been qualified according to the rules of the Department of Science and Art. The Council, however, trust that the measures adopted by the Fine Arts Committee, under whose immediate control the school is now placed, will be successful in obtaining the services of pupils possessing the necessary qualifications.

On the 7th of October, Mr. H. A. Bowler, Inspector in the Department of Science and Art, in conjunction with the Head Master, made an examination of the drawings of the pupils, and awarded 31 prizes in bronze medals, books, instruments, &c., marking seven with the distinction of honourable mention. As these latter receive no prizes from the Department, the Council intend presenting each student with a suitable certificate, as a permanent record of this distinction. A return of the students who have obtained prizes will be found in the Table (F.)

Notwithstanding the improved aspect which the School of Art presents, the Council consider that much may be done, without infringing any of the rules of the Department of Science and Art, which would tend to raise its character and render it more worthy of the Society. Some special encouragement for works in the higher branches of art, for art applied to certain branches of ornament manufacture, for the promotion of specialties, such as lithography and wood-engraving, might, the Council feel convinced, be held out to pupils with advantage.

With such views, the Council, with the co-operation of the Committee of Fine Arts, have already taken steps to provide the attendance of living models for the use of the more advanced students, and will be prepared, when the fitting time arrives, to take the other matters above referred to into consideration.

The number of pupils instructed in the school during the last session amounted to 392.

Gallery of Casts and Statues.

During the vacation the Committee of Fine Arts had the valuable collection of casts and statues belonging to the Society properly cleaned and repaired, the pedestals repaired and painted, and several new ones procured, a work which has had the effect of rendering the Statue Gallery one of the most attractive and instructive of the Society's departments.

A very beautiful marble statue, life size, of a Discobolus, by Kessel, the valuable bequest of the late Mrs. Putland, of Dublin, has been lately received, and now occupies a place in the Society's premises.

In the course of the year the gallery, which is open to the public on one day only in each week, was inspected by 7,400 persons.

In the month of March the prize drawings of the students of the several schools of Art throughout the kingdom were exhibited free to the public in the Gallery, in the daytime and in the evening, and were visited by 1,218 persons. During the Christmas vacation the photographs of the Paris Universal Exhibition, presented by the Board of Trade to the Society, were also exhibited free to the public, and visited by 360 persons.

The Society continues to afford to kindred institutions, under proper restrictions, accommodation for holding their meetings in its rooms, a privilege of which they regularly availed themselves during the current year.

The Council, in conclusion, submit the following summary of the attendance of the public (exclusive of the members of the Society) on the several departments during the year 1856.

Botanic Gardens	32,900
Museum of Natural History	31,811
Museum of Agriculture	25,370
Library (readers)	9,494
Statue Gallery	7,400
School of Art (individuals instructed)	392
Exhibition of Prize Drawings	1,218
Exhibition of Photographs	360
Evening Meeting (18 months)	737
Agricultural Exhibitions	12,763
Distribution of Agricultural Prizes	350
Lectures on Physics	2,722
——— Chemistry	3,181
——— Zoology	1,524
——— Botany	807
——— Mineralogy and Geology	6,572
Total	137,401

By order of Council,
W. E. Steele, M.D.,
Assistant Secretary.

31st Dec. 1856.

Appendix C.

Report of Royal Dublin Society.

(A.)

Return of Donations received at Botanic Gardens for the Year ending 31st December 1856.

A. J. Walsh, Esq., M.D., M.R.D.S., Harcourt Street:—One large parcel of mixed seeds from the West Indies: six kinds of seeds from the East Indies.

Mrs. Denroche, Philipsville, Alleghany, New York County, U. S.:—10 papers of seeds; 14 kinds of North American seeds.

From M. E. Ortgies, Director of Botanic Garden, Zurich:—256 kinds of rare seeds; 253 species of rare plants, many of which were not previously cultivated in the British Isles.

Mr. Baxter, Botanic Garden, Oxford:—One paper of seeds; six kinds of aquatic plants, and one plant of the Chinese rice paper plant, *Aralia papyrifera*.

Professor Harvey, M.R.D.S., per Mrs. Todhunter, Sir John Rogerson's Quay:—12 papers of seeds of rare ferns from the Fejee Islands; two papers of tree fern seeds from New Zealand.

Mr. Cunningham, Nurseryman, Liverpool:—Six kinds of rare trees; eight rare kinds of plants.

Mr. Frazer, Nurseryman, Comeley Bank, Edinburgh:—Three kinds of rare plants; 10 kinds of valuable plants.

From Sir Robert Shaw, Bart., M.R.D.S., Bushy Park:—One rare epiphytical plant.

From Mr. Bain, College Garden:—One rare epiphytical orchedaceous plant.

From Sir Robert Harty, Bart., M.R.D.S.:—One package of mixed seeds from West Indies, &c.

From Mr. Edward Johnstone, 5, Upper Fleet Street:—Two parcels of seeds from the governor's garden at Honolulu.

From his Grace the Archbishop of Dublin:—Cuttings of orange-berried ivy, and of the white variety of Solanum dulcamara (bitter sweet).

From Colonel White, Newtown Manor, Sligo:—A large package of seeds of *Araucaria imbricata*, and parcel of seeds of another plant at present unknown to us.

From F. M. Jennings, Esq., Cork:—One package of seeds of some papilionaceous plant, collected at Oregon, N. A.

From John Ball, Esq., M.P., &c.:—One package of wheat taken from a mummy at Thebes.

From Mr. Fennessy, Nurseryman, &c., Waterford:—Nine papers of seeds from Texas.

From Miss Hamilton, 23, Portland Place, Dublin:—One paper of seeds from Australia.

From Richard Bayley, Esq., Kingstown:—17 papers of seeds from the Himalayas.

From Terence O'Reilly, Esq., Ballybeg, County Meath, Navan:—One paper of seeds from Australia.

From Dr. M'Munn, Surgeon, Royal Artillery, Crimea:—One paper of seeds, presented by Dr. M'Munn, Cavendish Row.

From George Irvine, Esq., Prussia Street:—Four papers of seeds from Australia.

From Gilbert Burns, Esq., M.R.D.S., Knockmaroon House:—17 papers of seeds from New Zealand and a few dried mosses.

From M. Max Leichtlin, Carlsruhe, Baden:—76 kinds of seeds of ferns.

From Mr. Short, Gardener to his Grace the Duke of Leeds:—Two papers of seeds.

From Hugh Moore, Esq., Cremorne, Roundtown:—Parcel of offsets of hardy auriculas.

From Charles Cobbe, Esq., M.R.D.S., Newbridge House, Donnybate:—One parcel of seeds of Pinus maritimus.

From Mrs. Robert Tottenham:—One parcel of seeds.

From his Grace the Archbishop of Dublin:—One parcel of seeds of Tramanda cabbage, from Portugal.

From Mr. Flynn, Gardener, Marlfield, Clonmel:—One paper of seeds of double anemones.

From Messrs. Rollison, Tooting, Surrey:—30 kinds of rare and valuable plants.

From J. Montgomery, Esq., Civil Service, Lahore:—36 kinds of East India seeds.

From R. J. Orpen, Esq., M.R.D,S., 41, North Great George Street:—Package of mixed seeds, including some of gourds.

From Hon. Captain Arbuthnot:—Two plants from the Crimea, and one packet of seeds.

From —— Haughton, Esq., Athy:—Six plants of fly orchis, Ophrys muscifera.

From Mr. Jackson, Nurseryman, Kingston on-Thames:—10 rare species of plants.

From R. J. Garden, Esq., Major on Staff, Asia Minor;—One package of seeds.

From J. Rogers, Esq., Chelsea:—One package of seeds.

From Richard Mills, Esq., Upper Leeson Street:—136 kinds of East Indian seeds.

From Miss Thornton, Kingstown, sister to Surgeon Thornton, 9th Regiment Foot:—Six small boxes filled with roots of bulbous plants, collected by the latter in the Crimea.

From Mr. James Tweedie, Corresponding Member R.D. Society, Buenos Ayres:—100 kinds of seeds, and 10 kinds of grass seeds, from South America.

From Lord Talbot de Malahide, V.P.R.D.S.:—One head of Moha grass.

From Mr. Moore, Botanic Garden, Chelsea:—14 kinds of tender ferns.

From Mr. Marnock, Botanic Gardens, Regent's Park, London:—70 species of plants.

From M. Bouché, Director, Botanic Garden, Berlin:—73 species of plants, principally ferns.

From E. Brennan, Esq., M.R.D. Society:—Six kinds of orchidaceous plants.

From —— Darling, Esq., Trinidad, per the Rev. W. Vesey, Dublin:—One box with a miscellaneous assortment of orchidaceous plants.

From Mr. Low, Nurseryman, Clapton, London:—25 valuable plants.

From Mr. Henderson, Nurseryman, Pine Apple Place, London:—36 kinds of valuable plants.

From Louis Van Houtte, Nurseryman, &c., Ghent:—37 very rare and valuable kinds of plants.

From Mr. M'Nab, Royal Botanic Garden, Edinburgh:—22 species of rare plants, among which was the plant which produces the Cuba Bast *Hibiscus elatus*.

From Gilbert Cockburn, jun., Vesey Place, Monkstown:—Four kinds of seeds from Australia.

Botanical Museum.

From Miss Macartney, 28, Blessington Street:—A Caffre milk-pot, made out of a species of gourd.

From D. Moore:—Some rare fruits of coniferous plants from the north of Italy, collected on botanical tour.

From Richard O'Reilly, Esq., M.R.D.S., and W. T. March, Esq., H.M.R.D.S., Clerk to the Crown, Kingston, Jamaica, the following articles, viz.:—34 large sections of woods grown on the Island of Jamaica; four small sections ditto; seven samples of leather; three kinds of starch; two bottles of seeds of plants called by the local name of "Divi Divi," *Cæsalpinia Coriaria*; one ditto ground seeds of same; one ditto powder of "Garranca;" four fruits of the "Baobab," or monkey bread, *Adansonia digitata*; one Calabash fruit; five fruits of *Hura crepitans*; two halters for horses, made of bark of *Daphne tinifolia*; 16 samples of various kinds of barks used in Jamaica; one rope made from the Moha tree, *Hibiscus populifolia*; four samples of lace bark, *Lintearea lagetto*; 18 kinds of seed-vessels of plants; seven samples of various gums; seeds of *Quassia amara* and *Quassia excelsa*; ditto of *Guilindina bonduc*.

From his Grace the Duke of Leinster, M.R.D.S., Carton:—Fine specimens of the cones of cedar of Lebanon and of the Norway spruce fir.

Appendix C.

REPORT OF ROYAL DUBLIN SOCIETY.

From W. Wilkie, Esq., Phœnix Park :—Specimens of *Pinus excelsa*, Bhotan pine, destroyed by the pine beetle, *Hylurgus piniperda*, along with the insect.

From Mr. Smith, Gardener to his Excellency the Lord Lieutenant:—Stems of peach and plum trees, joined by grafting, showing that the woods of the stock and graft remain separate during the life of the plants.

From Miss Macartney, 28, Blessington Street:—One fine spike of Indian corn from Cape of Good Hope; branch and large spines of the plant called by the local name of "Wait a Bit," which the British troops found so troublesome to get through when engaged in the late Caffre war.

From Thomas Drury, Esq., M.R.D.S:—A pair of beautiful swans for the ponds.

(Signed) D. MOORE, *Curator.*

31st Dec. 1856.

(B.)

RETURN of DONATIONS received for MUSEUM of NATURAL HISTORY of the ROYAL DUBLIN SOCIETY, for the Year ending December 31, 1856.

For the British Collections.

John Robert Kinahan, Esq., M.B., M.R.D.S., Sea View, Donnybrook:—Ten species of Crustacea, including *Xantho florida*, from the Island of Valentia and from the Dublin coast, *Pagurus Bernhardus*; *P. Cuanensis*, and *P. Hyndmanni*; six species of Mollusca, including *Cochlodesma prætenue* and *Thracia Phaseolina*.

The Rev. Alfred M. Norman, Kibworth, Leicestershire, per Dr. Kinahan:—Four species of crustacea from the British coast; nine species of mollusca, including *Bulimus lackhamensis, Helix revelata*, and *Trochus exiguus*.

John G. Rathhorne, Esq., M.R.D.S., Dunsinea, Co. Dublin:—A specimen of the melodious willow wren (*Sylvia Hippolais Temm*), shot by him at Dunsinea on the 18th of June 1856.

Edward Waller, Esq., C.M.R.D.S.:—A small collection of native shells.

Ed. Percival Wright, Esq., A.B., M.R.D.S., 5, Trinity College:—Additions to the collection of British Coleoptera, including the rare Irish species *Nebria complanata, Calathus nuibgena, Bembidium pallidipenne, &c.*, and also to the British collections of Lepidoptera and Mollusca.

Robert H. Twigg, Esq., No. 4, Kew Terrace, Glasgow:—A northern stone crab (*Lithodes maia*, Leach), Isle of Arran, N.B.; a lingthorn (*Luidice fragillissima*, Forbes), and a snake.

Captain Cookman, 99th Regiment, M.R.D.S., Beggars' Bush Barracks:—58 species of fossil shells from the tertiary formation of Bartin, Hordwell, and the Isle of Wight, 4 specimens of *Pholas*, and 3 specimens of lead ore from Caim Mine, Co. Wexford.

Saul Sanders, Esq., 10, Sydney Avenue, Blackrock.—*Solaster papposa* and *Porcellana longicornis*.

Mrs. Thomas Townsend, Smithville, Castletownsend, Co. Cork:—Two large specimens of *Psammobia vespertena*.

Mrs. Nangle, 11, Percy Place:—A small series of *Balæa fragilis* from the Co. Down.

William Robert Taggart, Esq., 5, Trinity College:—A window swallow (*Hirundo urbica*).

Joseph Byrne, Esq., William Street:—A sordid dragonet (*Callyonymus dracunculus*), and 12 specimens of the freshwater crayfish (*Astacus fluviatilis*).

G. F. Brockholes, Esq., 7, Egerton Terrace, Birkenhead:—65 specimens of British Lepidoptera.

F. Jones, Esq., High Street, Bala, Wales:—A white variety of the mole (*Talpa Europæa*).

Charles Farran, Esq., M.D., 9, Lower Mount Street:—One large specimen of *Akera bullata*.

John Knight Boswell, Esq., M.R.D.S., Kingstown:—A young otter (*Lutra vulgaris*).

George Sanders, Esq., Sydney Avenue, Blackrock:—Two eggs of the sand marten (*Hirundo riparia*); a Richardson's skua (*Lestris Richardsonii*); a dunlin (*Tringa variabilis*); a knot (*Tringa canutus*); two-ring dotterel (*Charadrius hiaticula*); a green cormorant (*Phalacrocorax graculus*); a lesser weaver fish (*Trachinus vipera*).

Ffolliott Barton, Esq., M.R.D.S.:—*Stigmaria ficoides*, from Clonelly, Drumkeerin, Co. Fermanagh.

Captain Gill, Baldoyle, Co. Dublin:—Some specimens of hæmatite and rock crystal.

Miss Nina Tipping, Enfield, Co. Kildare:—A small collection of native Lepidoptera.

Charles Mellson, Esq., 16, Leinster Terrace, Rathmines:—A shrew (*Sorex rusticus*).

Miss Birch, Lansdowne Terrace, Kenmare, Co. Kerry, per Dr. Edmund W. Davy, M.R.D.S.:—A good specimen of the bird's-foot sea-star (*Palmipes membranaceus*).

William Drury, Esq., M.R.D.S., 14, Hatch Street:—A long-eared bat (*Plecotus auritus*).

John White, Esq., 6, Church Lane:—A piece of carbonized matter taken from the ruins of Covent Garden Theatre.

Rev. Arthur R. Hogan, Corsham, Chippenham:—27 specimens of British coleoptera.

Colonel Vandeleur, M.R.D.S., Kilrush, Co. Clare:—A fine specimen of the *Loligo vulgaris*, taken in the Shannon.

For the General Collections.

Mrs. Carew Smyth, 52, Lower Baggot Street, per Dr. Beauchamp, M.R.D.S.:—40 specimens of birds from Trinidad, six humming birds' nests, a shell of the *Argonauta argo*, and the rattle of a rattle-snake.

William Carte, Esq., L.R.C.S., Staff Assistant-Surgeon, Royal Infirmary, Phœnix Park:—A large and highly interesting collection of birds from the Crimea, illustrative of the ornithology of that locality. Also a very fine and perfect skeleton of a buffalo (*Bubalus buffalus*); three bats; three species of rats (*Mus rattus*, *M. sylvestris*, and *M. musculus*). A small collection of serpents, lizards, coleoptera, etc.

John Robert Kinahan, Esq., M.B., M.R.D.S., Seaview, Donnybrook:—Australian crustacea, collected by himself, including the following species;—*Halimus auritus? Ozius? Serratifrons* (N. S.); *Pilumnoides perlatus*; *Portunus integrifrons*; *Halicarcinus planatus*; *Mycteris subverrucatus*; *Hemigrapsus quadridentatus*; *Hemigrapsus sexdentatus*; *Heterograpsus octodentatus*; *Philyra læris*; *Typæa porcellana* (N.S.) Together with a few species of insects, arachnida, myriapoda, and sponges from Port Philip.

From the Chinchas Islands, Peru:—The cranium of a sea leopard (*Otaria jubata*); an adult and young guano bird (*Puffinuria urinatrix*); 16 species of crustacea, including *Pilumnoides Danai* (N.S.); *Porcellana violacea*; *P. carinata* (N. S.); *P. dubia* (N. S.); *P. striata*; *Goniograpsus simplex*; *Panopœus crenatus*; *Hepatus Chiliensis*; *Paraxanthus sexdecimdentatus*; and ten species of *Fissurella* and *Patella*; a sooty albatross (*Diomedea fuliginosa*); and a specimen of the spectacled petrel (*Procellaria conspicillata*), taken in the high seas south of New Zealand.

George Norris, Esq., 36, Westmoreland Street:—A small collection of coleoptera from China and the East Indies.

Vere Webb Macnally, Esq., 8, Old Mount Pleasant, Ranelagh:—A small collection of foreign marine shells.

Mrs. Thomas Locke, 12, Marino Crescent, Clontarf:—A globe fish from St. Vincent, West Indies.

Captain Henry, 4th Dragoon Guards, Waterloo Road, per Jolliffe Tuffnell, Esq., M.R.D.S.:—Four bird-skins from the Crimea, viz., an eagle, a hobby (*Falco subbuteo*), a short-eared owl (*Otus brachyotos*), and a little bittern (*Botaurus minutus*).

Richard John St. George, Esq., Calcutta:—A fine collection of fossil ferns, &c. &c., from the Rajmahal Hills, India.

Appendix C. — Report of Royal Dublin Society.

Lieutenant John Hutchinson, R.N., H.M. ship "Herald," Sydney:—A collection of war implements, dresses, &c. &c., from the Fejee Islands and Esquimaux.

Wm. Thomas March, Esq., H.M.R.D.S., Clerk of the Crown, Kingston, Jamaica:—A large and valuable collection of birds from Jamaica, illustrative of the ornithology of that island.

His Grace the Archbishop of Dublin, per Dr. Croker, M.R.D.S.:—A fine specimen of the nest of the *Mygale Ionica*, brought from Corfu.

George Macdona, Esq., M.R.D.S., Molesworth Street:—Two quivers, twenty-two arrows, two bows, two shields, one churn, two bird-skins, one rattle-snake, one centipede, one tarrantula, one scorpion, and an arrow point used prior to the introduction of iron from Texas.

C. B. Lane, Esq., Stratton Lodge, Torquay:—25 species of birds from Rio Janeiro.

Richard W. Boyle, Esq., Upper Merrion Street:—A fine specimen of a lynx (*Felis lynx*), a wolf (*Canis lupus*), and a glutton (*Gulo luscus*) from Norway.

John Tuthill Bagot, Esq., Member of the Legislative Council of South Australia:—A wedge-tailed petrel (*Puffinus sphenurus*) from S. Australia.

Thomas Oldham, Esq., M.R.D.S., Calcutta, per Miss Oldham, 9 Pembroke Road:—Specimens from India, as follows, viz., two crania of the *Macacus cynomolgus*; one cranium of the *M. nemistrinus*; one of the *M. resus*; one of the *Papio obscurus*; one of the *Cervulus moschatus*; one of the *Canis aureus*, and one of the young of the same species: one of the *Felis domestica*; one of the *Canis pallipes*; one of the *Hyæna striata*; specimens of the *Cynopterus marginatus*, *Nycticejus Temminckii*, *Megaderma spasma*, and a *Taphozous?*; nine sets of horns; four skulls with horns; eight skins of animals; two tortoise-shells; three dried snake-skins, and some jars containing snakes, lizards, &c., among which may be mentioned good specimens of the *Teliqua rufescens*, *Leiolepis bella*, &c. &c.

W. R. Rynd, Esq., C.M.R.D.S., Messina:—A very interesting collection of Tertiary fossils from Messina, illustrative of the Geological formation of that locality.

From the Council of the Royal Zoological Society of Ireland, per Robert Ball, L.L.D., M.R.D.S.:—60 specimens of various animals, including a very interesting specimen of the female Chimpanzee, *Troglodytes niger*.

(Signed) Alexander Carte, *Director*.

(C.)

Return of Books presented for the Library of the Royal Dublin Society from the 1st November 1855 to the 13th November 1856.

From the Author:—

Bankrupt Law, on the Amendment of. 8vo. Dub., 1855.

From the Rev. Beaver H. Blacker, A.M., M.R.D.S., St. Mary's, Donnybrook:—

Catalogue Bibliotheca Croftsiana—Catalogue of the Library of the late Rev. Thomas Crofts, A.M., Chancellor of Peterborough. 8vo. Lond., 1783.

Catalogue Bibliotheca Pinelliana—Catalogue of the Library of Maffei Pinelli, late of Venice. 8vo. Lond., 1789.

Catalogue of the Library of Isaac Reed, of Staple Inn. 8vo. Lond., 1807.

Catalogue of the Library of Sir Samuel Romilly.

Daniæ et Norwegiæ de Regno, et de Holstatiæ Ducatu Sleswicensi Tractatus varii. 18mo. Ludg. Batav., 1629.

Falconer (William, M.D.) A Dissertation on the Influence of the Passions upon the Disorders of the Body. Third Edition. 12mo. Lond., 1796.

Falconer (William, M.D.) Observations respecting the Pulse. 8vo. Lond., 1796.

Irish Gentleman. The Scientific Tourist through Ireland. 12mo. Lond., 1818.

Lavnoii (Johannis).—De Mente Tridentini Concilij circa Satisfactionem in Sacramento Penitentiæ Dissertatio. Editio secunda. 8vo. Parisiis, 1664

Musarum Anglicanarum Anelecta, sive Poemata quædam melioris Notæ. seu hactenus inedita, seu sparsim edita, in duo volumina congesta. Editio tertia. 2 vols. 12mo. Lond., 1714.

Orange, House of. Lives of the Princes of the Illustrious House of Orange. 8vo. Lond., 1734

Parœbolæ, sive Excerpta e corpore Statutorum Universitatis Oxoniensis. 8vo. Oxonii., 1794.

Report (for 1854-5) of the National Association for the Education of the Deaf and Dumb Children of the Poor of Ireland. 8vo. Dub., 1855.

Sophocles.—The Philoctetes of Sophocles, with English Notes by G. Burgher, A.M. 8vo. Lond., 1833.

Sophocles.—The Trachiniæ of Sophocles, chiefly according to the text of Brunck. By Rev. John Brasse, D.D. 8vo. Lond., 1830.

Woodward (Josiah, D.D.)—Fair Warnings to a Careless World. Third Edition. 12mo. Lond., 1717.

From John Ribton Garston, Esq., M.R.D.S.:—

Cavallo (Tiberius).—A Complete Treatise on Electricity. 8vo. Lond., 1777.

Hooker (Richard).—The Works of, in Eight Books of the Ecclesiastical Polity. . . . The Life of the Author by Isaac Walton. Folio. Lond., 1705.

Keate (George).—An Account of the Pelew Islands. 8vo. Dub., 1788.

Saavedra-fajardo (Don Diego).—Republica Literaria, Obra Posthuma. 8vo. Valencia, 1772.

Dionisii Halicarnassii de Thucydidis Historia Judicium; Andrea Dubitio Pannonio interprete. 4to. Venetiis, 1560.

From John Ribton Garstin, Esq., M.R.D.S.:—

Du Moulin (Pierre).—Bouclier de la Foy, ou Defence de la Confession de Foy des Eglises Reformees du Royaume de France. 8vo. A Geneva, 1619.

Essays.—Twenty Essays on Literary and Philosophical Subjects. 12mo. Dub. 1791.

Haughton (Graves Chamney, A.M., F.R.S., M.R.A.S.)—Account of an Arabic Gravestone, Abyssinia. 4to. Lond., 1830.

Malton (Thomas).—A Compleat Treatise on Perspective on the True Principles of Dr. Brook Taylor. Second Edition, folio. Lond., 1779.

Nieupoort (A. G. H.)—Rituum, qui olim apud Romanos obtinuerunt, succincta Explicatio. 12mo. Venetiis, 1771.

Rowning (J. M. A.)—A Compendious System of Natural Philosophy. In Four Parts. 2 vols. 8vo. Lond., 1764–65.

From the Provost and Senior Fellows of Trinity College, Dublin:—

Dublin University Calendar for the Year 1856, corrected to December 15, 1855. 8vo. Dub., 1856.

From John Lentaigne, Esq., M.D., M.R.D.S.:—

Exposition des Produits de l'Industrie de toutes les Nations, 1855. Catalogue Officiel. Deuxième Edition. 8vo. Paris, 1855.

From the Author:—

Fisher (Joseph).—The Position and Prospects of Ireland. Originally published in "The Waterford Mail." 8vo. Waterford, 1855.

From the Author, M.R.D.S.:—

Fulton (Henry, M.D.)—Plans, Sections, and Descriptions of a Model Cottage. 8vo. Dub., 1852.

Fulton (Henry).—The Facts and Fallacies of the Sabbath Question. Dub., 1856.

From the Authors, M.R.D.S.:—

Galbraith (Joseph A., M.A., F.T.C.D.) and Haughton (Samuel, M.A., F.T.C.D.)—Manual of Astronomy. 8vo. Lond., 1855.

Galbraith (Joseph A., M.A., F.T.C.D.), and Haughton (Samuel, M.A., F.T.C.D.)—Manual of Hydrostatics. Second Edition. 8vo. Lond., 1855.

Galbraith (Joseph A., M.A., F.T.C.D.), and Haughton (Samuel, M.A., F.T.C.D.)—Manual of Optics. Second Edition. 8vo. Lond., 1855.

Appendix C.

REPORT OF ROYAL DUBLIN SOCIETY.

From the Author :—

Hoare (Edward Newenham, A.M., Dean of Waterford).—English Roots and the Derivation of Words from the Ancient Anglo-Saxon. Second Edition. 8vo. Dub., 1856.

From the Author, M.R.D.S.:—

Hughes (James S., M.D.) Attempted Suicide by Hanging. 8vo. Dub., 1854.

Hughes (James S.)—Clinical Lectures on Erysipelas. 8vo. Dub., 1854.

Hughes (James S.)—Clinical Observations on Morbus Coxæ. 8vo. Dub., 1854.

Hughes, (James Stannus, M.D.)—A Case of Fracture of the Spine in the Cervical Region. 8vo. Dub., 1855.

From the Author (The Most Rev. R. Whately, D.D., Archbishop of Dublin):—

Introductory Lessons on Morals, by the Author of "Introductory Lessons on the British Constitution." 12mo. Lond., 1855.

Whately, (Richard, D.D., Archbishop of Dublin).—Bacon's Essays: a Lecture delivered November 20, 1855. 8vo. Dub., S.A., 1856.

From the Editor (John J. Lyons, Architect):—

Irish Reporter (a Monthly Journal): Nos. 1. 2. 3., January, February, and March, 1855. Folio. Dub., 1856.

From the Royal Agricultural Society of England:—

Journal of the Royal Agricultural Society of England. Vol. xvi., Part 2, No. 36. 8vo. Lond., 1856.

Journal. Vol. xvii., Part 1, No. 37. 8vo. Lond., 1856.

From the Statistical Society of London:

Journal of the Statistical Society of London. Vol. xviii., Part 4, Dec. 1855. Vol. xix., Part 1, March 1856. 8vo. Lond., 1855–56.

From the Chancellor and Senate of the London University:—

London University Calendar 1856. 8vo. Lond., 1856.

From his Royal Highness Prince Albert:—

Macgillivray (William, LL.D.)—The Natural History of the Dee Side and Braemar. Edited by Edward Lankester, M.D. 8vo. Printed for private circulation. Lond., 1855.

From the Government of the U.S. America:—

Report of the Commissioners of Patents for the Year 1853.—Agriculture, 84. Washington, 1854.

From the Registrar General:—

Return of the Agricultural Produce of Ireland for the Year 1854. Folio. Dub., 1855

From the Smithsonian Institution, Washington U.S.A.:—

Smithsonian Institution, Eighth Annual Report of the Board of Regents. 8vo. Washington, 1854.

Smithsonian Institution, Ninth Annual Report of the Board of Regents. 8vo. Washington, 1855.

Smithsonian Contributions to Knowledge. Vol. vii. 4to. Washington, 1855.

From the North of England Institute of Mining Engineers:—

Transactions of the North of England Institute of Mining Engineers. Vol. iii. 1854–55. 8vo. Lond., 1855.

From Mr. Walter White, at the request of the Author:—

Ville (M. Georges).—Recherches Expérimentales sur la Végétation. Absorption de l'Azote de l'Air par les Plantes. Rapport fait par M. Chevreul. 8vo. Paris, 1855.

From El Observatorio de Marina de San Fernando:—

Almanaque Nautico para el Año 1857. Calculado de Orden de S. M. en el Observatorio de Marina de la Ciudad de S. Fernando. 8vo. Cadiz, 1855.

From Major-General Thomas Falls, M.R.D.S.:—

Bible.—Extractos de las Santas Escrituras traducidos al Castellano. 8vo. s. l. s. a.

Bible.—La Biblia in Prigione. 18mo. Lond., 1853.

From Hugh Ferguson, Esq., M.R.D.S.:—
Boyer (A.)—The History of Queen Anne. Folio. Lond., 1735.
De Rapin Thoyras (M.)—Histoire d'Angleterre. 10 tom. 4to. A la Haye, 1724–27.
Holte (Sir Lister.)—His Collection, in one volume, of Early Editions of Poems, for which see in Catalogue.—Addison (Mr.), Blenheim, Cambridge; Catherall (James), Daniel (Rev. Mr.), Essay on the Poets, Last Day; Pope (Mr.), Tickell (Mr.), Young (Edward).

From the Trustees of the Clonmel Mechanics' Institute:—
Catalogue of the Books in the Clonmel Mechanics' Institute. 8vo. Clonmel, 1855.

From the Aborigines Protection Society:—
Colonial Intelligence, or Aborigines' Friend. Volumes i., ii iii., iv. 8vo. Lond., s. a. 1847–1854.

From the Rev. William Urwick, D.D., M.R.D.S:—
De Bow, (J. D. B.)—Statistical View of the United States; being a Compendium of the Seventh Census. 8vo. Washington, 1854.

From the Author:—
Hennessy (Henry, M.R.I.A.)—Notes on Meteorology. 8vo. Dub., 1856.

From the Author:—
Hood (W. Charles M.D.)—Bethlehem Hospital Report, 20th January 1856. 8vo Lond., 1856

From the Commissioners of Patents:—
Journal.—The Commissioners of Patents Journal, 1854–55. 2 vols. 8vo. Lond., 1854–55.
Patents.—Specifications of Patents of Inventions granted since March 2, 1617. 8vo. Lond., s. a. adhuc curr.
Woodcroft (Bennet)—Alphabetical Index of Patentees of Invention, from March 2, 1617, to October 1, 1852. 8vo. Lond., 1854.

From the Geological Society of Dublin:—
Journal of the Geological Society of Dublin. Vol. vii. Parts 1, 2. 1855–56. 8vo. Dub., 1856.

From the Dublin Statistical Society:—
Journal of the Dublin Statistical Society, April 1856. 8vo. Dub., 1856.

From the Statistical Society of London:—
Journal of the Statistical Society of London. Vol. xix. Part 2. 8vo. Lond., 1856.

From the Author, by Dr. Fulton:—
M'Cormac (Henry, M. D.)—On the Nature and Treatment and Prevention of Pulmonary Consumption, and incidentally of Scrophula. 8vo. Lond., 1855.

From Henry Fulton, M.D., M.R.D.S:—
Oxford M.A.—The People's Sunday: a Letter to Lord Robert Grosvenor on his Sunday Trading Bill. Second edition. 8vo. Lond., 1855.
National Sunday League Record.

From the Commissioners of Dublin Metropolitan Police:—
Medical Statistics of the Dublin Metropolitan Police for the year 1855. Folio. Dub., 1856.

Hommage de l'Auteur:—
Ménabréa (L. F., Colonel de Génie Militaire).—Lois Générales de divers Ordres de Phénomènes. Extrait des Mémoires de l'Académie des Sciences de Turin. Série 2. Tom. 16. 4to. Turin, 1855.

From the Chief Secretary's Office, Dublin Castle:—
Queen's University in Ireland.—Report of a Competitive Examination for the office of Professor of the Celtic Languages in the Queen's College, Galway. Folio. Dub., s. a., 1856.

From the Directors of Convict Prisons in Ireland:—
Report (Second Annual) of the Directors of the Convict Prisons in Ireland for the year 1855. 8vo. Dub., 1856.

Appendix C.

REPORT OF ROYAL DUBLIN SOCIETY.

From the Royal Society of London:—

Royal Society, 30 November 1855.—List of Fellows. Lond., s.a.

Transactions (Philosophical) of the Royal Society of London for the year 1854. Vol. cxliv. Part 2. And for the year 1855. Vol. cxlv. 4to. Lond., 1854–55.

Proceedings of the Royal Society. Vol. viii. No. 21. 8vo. Lond., 1856.

Transactions (Philosophical) of the Royal Society, London, for the year 1856. Vol. cxlvi. Part 1. 4to. Lond. 1856.

From John Woodrooffe, M.D., Hon. M.R.D.S.:—

Ruyschii (Frederici).—Opera Omnia Anatomico-Medico-Chirurgica huc usque edita. 4 tom. 4to. Amstelodami, 1737.

From the Author:—

South (Sir James, F.R.S.); a Letter to the Fellows of the Royal and the Royal Astronomical Societies, in reply to the Obituary Notice of the late Rev. Richard Sheepshanks (for private circulation only). 8vo. Lond., 1856.

Review of a Letter from Sir James South, F.R.S., (*re* Sheepshanks). Reprinted from the "Mechanics' Magazine." 8vo. Lond., 1856.

From the Royal Institution of Great Britain:—

Transactions.—Notices of the Meetings of the Members of the Royal Institution of Great Britain. Parts 1, 2, 3. 4, 5. 8vo. Lond., 1851–52–53–54–55.

Transactions. Part 6. July 1855. 8vo. Lond. 1856.

From the Author:—

Walkinshaw (Clothworthy).—Prevention of the Decay in Potatoes. Second edition. 8vo. Belfast, 1856.

From the Author:—

Weld (Isaac, V.-P.R.D.S).—A Memoir of a Government appointment conferred on mein 1801, and then worth 1,000*l.* per annum. 8vo. Dub., 1856.

From William John Fitzpatrick, Esq., M.R.D.S., the Author:—

Who wrote the Waverley Novels? 8vo. Lond., 1856.

From the Author:—

Aikin (Thomas, M.D., F.R.S.C.I., M.R.D.S.)—Observations upon the Nature and Treatment of Cholera. Dub., 1854

From the Author:—

Angeli (Basilio).—Answer to Alleged Errors in the Italian Translation of Sir Robert Kane's Address on the Opening of the Queen's College, Cork. 8vo. Dub., 1856.

Woodcroft (Bennet).—Alphabetical Index of Patentees and Applicants for Patents of Invention, from 1st October 1852 to 31st December 1853. 8vo. Lond., 1854.

Woodcroft (Bennet).—Alphabetical Index of Patentees and Applicants for Patents of Invention, for the year 1854. 8vo. Lond., 1855.

Woodcroft (Bennet).—Alphabetical Index of Patentees and Applicants for Patents of Invention, for the year 1855. 8vo. Lond., 1856.

Woodcroft (Bennet).—Chronological Index of Patents applied for and Patents granted, from 1st October 1852 to 31st December 1853. 8vo. Lond., 1854.

Woodcroft (Bennet).—Chronological Index to Patents applied for and Patents granted, for the year 1854. 8vo. Lond., 1855.

Woodcroft (Bennet).—Reference Index of Patents of Inventions, from March 2, 1617, to October 1st, 1852. 8vo. Lond., 1855.

Woodcroft (Bennet).—Appendix to Reference Index to Patents of Invention. 8vo. Lond., 1855.

Woodcroft (Bennet).—Subject-matter (made from titles only) of Patents of Invention, from March 2, 1617, to October 1, 1852. 2 Parts. 8vo. Lond., 1854.

From the Author:—

Woodcroft (Bennet).—Subject-matter Index to Patents applied for and Patents granted, from 1st October to 31st December 1852. 8vo. Lond., 1855.

Woodcroft (Bennet).—Subject-matter Index of Patents applied for and Patents granted, for the year 1853. 8vo. Lond., 1856.
Woodcroft (Bennet).—Subject-matter of Patents applied for and Patents granted, for the year 1854. 8vo. Lond., 1856.
Woodcroft (Bennet).—Titles of Patents of Invention, chronologically arranged, from March 1617, to October 1, 1852. 2 Parts, 8vo. Lond., 1854.

From His Imperial Majesty the Emperor of All the Russias :—
Annales de l'Observatoire Physique central de Russie. Par A. T. Kupffer. 2 vols., 4to.
Année 1851. St. Petersbourg, 1853.
Année 1852. St. Petersbourg, 1855.

De la part du Muséum d'Histoire Naturelle :—
Archives du Muséum d'Histoire Naturelle. Tom 8. Livres 3, 4. 4to. Paris 1855-6.
Kupffer (A. T.)—Correspondance Météorologique. Publication Trimestrielle de l'Administration des Mines de Russie. Année 1853. 4to. St. Petersbourg, 1854.

From the Council of the British Association, by John Herbert Orpen, L.L.D., M.R.D.S. :
British Association for the Advancement of Science and Art: Report of the Twenty-fourth meeting, held at Glasgow in September 1855. 8vo. Lond., 1856.

From L. E. Foot, Esq., H.S.R.D.S. :—
Concours Agricole Universel de 1856. Catalogue des Animaux, Machines, Instruments et Produits Exposés. 8vo. Paris, 1856.

From the Author :—
Dill (Rev. Richard, A.M.)—Prelatico-Presbyterianism. Recent History of the Irish Prestbyterian Church. 8vo. Dub., 1856.

From James Richard Cooke, Esq., M.R.D.S. :—
Dobson (Mathew, M.D., F.R.S.)—A Medical Commentary on Fixed Air. 8vo. Chester, 1779.
Medical and Philosophical Commentaries, by a Society of Physicians in Edinburgh. 6 vols. 8vo. Lond., 1774.
Perceval (Thomas, M.D.)—Essays, Medical and Experimental. 3 vols. 8vo. Lond., 1773, 1776, 1787.
Parr (Samuel, M.D.)—A Philosophical Inquiry into Animal Motion. 8vo. Lond., 1771.

From John Tuthill Bagot, Esq., M.L.C., Adelaide, South Australia, by E. Bagot, M.D., M.R.D.S. :—
Kingston (George Strickland).—Register of the Rain-Gauge kept on West Terrace, Adelaide, from January 1, 1889, to 31st August 1850. Folio. Adelaide, S.A., 1580.

From James Haughton, Esq., M.R.D.S. :—
Lees (Dr. Frederick Richard).—An Argument for the Prohibition of Liquor Traffic. 8vo. Lond., 1856.

From the First Commissioner of Her Majesty's Works and Public Buildings:—
Mackenzie (Frederick).—The Architectural Antiquities of the Collegiate Chapel of Westminster, the late House of Commons. Atlas. Lond., 1844.

From (the Author) Colonel George Twemlow, Royal Bengal Artillery:—
Navy (British) Suggestions for felling Timber for the British Navy. By the Author of "Considerations on Tactics and Strategy," Colonel George Twemlow. 8vo. Clapham, 1856.

Hommage de l'Auteur:—
Dumeril (M.)—Considérations Générales sur les Classifications en Histoire Naturelle et . . . et du Plan de l'Ichthyologie Analytique. 4to. s. a. s. l. Paris, 1856.

Hommage de l'Auteur:—

Dumeril (le Docteur Auguste).—Description des Reptiles Nouveaux ou imparfaitement connus. Première Mémoire. Deuxième Mémoire. 4to. Paris, 1856.

Offert par l'Auteur:—

Dumeril (M. le Docteur Auguste).—Essai d'Application à la Classe des Reptiles, et Description d'un Saurien d'un Genre Nouveau. 8vo. s. l. 1854.

Hommage de l'Auteur:—

Dumeril (A. M. E.)—Ichthyologie Analytque, ou Essai d'une Classification Naturelle des Poissons. 4to. Paris, 1856.

Offert par l'Auteur:—

Dumeril (Auguste).—Monographie de la Tribu des Torpedinions ou Rares Electriques. 8vo.

Dumeril (Auguste).—Monographie de la Tribu des Scylliens ou Rousettes. (Poissons Plagiostomes). 8vo.

From the Author:—

Meekings (T. E. Massom).—Decimal Coinage, should it be international? 8vo. Lond., 1856.

Offert par la Muséum d'Histoire Naturelle de Paris:—

Muséum d'Histoire Naturelle de Paris.—Catalogue de la Collection Entomologique; Classe des Insects, Ordre de Coléopetères. Tom. 1. 8vo. Paris, 1850.

Muséum d'Histoire Naturelle de Paris.—Catalogue Méthodique de la Collection des Mammiféres, des Oiseaux. Par Isidore Geoffroy-Saint Hilaire, MM. Florent, Prevost, et Pucheran. 8vo. Paris, 1851.

Muséum d'Histoire Naturelle de Paris. — Catologue Méthodique de la Collection des Reptiles. P. A. M. E. Dumeril, A. N. M. Aug. Dumeril. 8vo. Paris, 1851.

From W. E. Steele, M.D., M.R.D.S., Registrar of the King and Queen's College of Physicians in Ireland:—

Pharmacopœia.—Supplement to the Pharmacopœia of the King and Queen's College of Physicians in Ireland, 1850. 8vo. Dub., 1856.

From Captain Edward Worth Newenham, Verdun:—

Poncelet (M.)—Cours de Méchanique; appliquée aux Machines, Ecole d'Application de l'Artillerie et de Génie. Sections 1, 2, 3, 5, 6, 7, 8. Lithogr. Folio. S. l. 1835, 1836.

Presented by the Author:—

Port Royal, a Week at, by Richard Hill. (Preface.) 12mo. Montego Bay, 1856

From George Macdona, Esq., M.R.D.S.:—

Report of the Commissioners of Patents (United States of America), for the year 1851; Part 1, Arts and Manufactures; Part 2, Agriculture, 8vo. Washington, 1852.

From Richard Dowden, Esq.:—

Report of the Cork Cuverian Society for the Session 1854-55, and the Addresses by Dr. Bole, Professor Shaw, and Richard Dowden Richard, Esq.

From the Royal Astronomical Society:—

Royal Astronomical Society, Memoirs of. Vol. 24. for session 1854-55 4to. Lond. 1856.

Royal Astronomical Monthly, Notice of, from November 1854 to June 1855. Vol. 15. 8vo. Lond. 1855.

From the Commissioners:

Statistical Tables of the Dublin Metropolitan Police for the year 1855 Folio. Dub. 1856.

From the Dublin Chemical Society:

Transactions, Fourth Annual Report of the Dublin Chemical Society. 8vo. Dub. 1850.

From the Imperial and Royal Venetian Institute of Science, Literature, and Art, by Consul-General Harris:—

Transactions, Atti dell Imp. Reg. Instituto Veneto de Scienze, Lettere, ed Arti. Tomo primo, serie terze. 8vo. Dispense 1, 2, 3, 4, 5, 7. Venezia, 1855–56.

From the Pathological Society of London:—

Transactions of the Pathological Society of London. Vol. 7, Session 1855-56. 8vo. Lond. 1856.

From the Author—

Wall, (Charles William D.D., Vice-Provost, T.C.D., M.R.D.S.,) an Examination of the Ancient Orthography of the Jews, and of the Text of the Hebrew Bible. Part the 3rd, vol. 1. 8vo. London, 1856.

(Signed) E. R. P. COLLES, *Librarian.*

(D.)

LIST of DONATIONS received for the AGRICULTURAL MUSEUM.

Robert Meekins, Esq., M.R.D.S., Glasthule House, Kingstown.—Specimens of rye grass, clover, &c., in various stages of preparation; and specimens of cockfoot and Timothy grass and clover.

—— Foster, Esq., Collon, Co. Louth.—Specimens of sandy oats in ear and pod.

Mr. Frederick H. Judge, Seville Place, Dublin.—Specimens of Bolton's Cattle Cure.

Joseph Thornly, Esq., High Street, Hull.—Specimens of artificial manures in a case for exhibitional purposes.

A. H. Bagot, Esq., M.R.D.S., Ballymoe, French Park.—Specimens of wheat, oats, and flax, from seed procured from Australia in 1851.

Doctor Kirkpatrick, Albert Farm, Glasnevin.—Specimens of this year's grasses, produced by the application of liquid manure, 15 inches in length; also specimens of various kinds of grain and green crops.

S. W. Thomas, Esq.—Patent impermeable cloth Toile des Bassins, manufactured by M. Hervé, 48, Taitboul, Paris; patented in France and England.

No. 1. Showing the waterproof qualities of the material, and its suitability for temporary cisterns, and for holding acids or covering buildings.

No. 2. Showing its use for covering packing cases for merchandise or eatables, or any goods liable to damage from damp or salt water.

No. 3. Specimen of the "Toile," representing the mode by which it is used for roofing. Attention is particularly requested to the simple and perfectly effectual manner in which the nails used for fastening are preserved from the action of the weather.

No. 4. Specimens of the material itself. This was made in 1854, and is much narrower than the "Toile" at present manufactured.

James Taylor Lacy, Esq., Secretary, Patent Nitro-Phosphate or Blood-manure Company, London.—Specimens of the following kinds of manure, contained in glass jars, and mounted on bronze pedestals.

1st. Sulphuric acid. 2nd. Turnip manure. 3rd. Corn manure. 4th. Dried blood. 5th. Animal charcoal. 6th. Ground coprolites. 7th. Fine and coarse coprolites mixed.

James Ritchie and Sons, Belfast.—Specimens in glass jars vitriolized bone compound; and specimens of flax and turnip manures, chemically prepared.

George Macdona, Esq., M.R.D.S., Molesworth Street, Dublin.—Specimens of clay from Texas, upon which cottons and vines were grown.

Silvester Rait, Esq., Rathmoyle, Edenderry.—Specimen of rye grass, the produce of the second cutting.

Appendix C.

REPORT OF ROYAL DUBLIN SOCIETY.

Mrs. Veevey.—12 specimens of flax from plants and flowers; two specimens of wood for the manufacture of paper; two specimens of Asbestos; a specimen of rug from the nettle flax; a pair inside soles made from the Bogdown and goat's hair; seven specimens of work by children from the fibre of plants and flowers.

Frederick Taylor, Esq., Molesworth Street, Dublin.—Specimens, in the raw and manufactured state, of the *Lavatera arborea*, cultivated in Connemara by Mr. Taylor for its fibres.

(Signed) A. CORRIGAN, *Curator.*

(E.)

FINANCIAL STATEMENT of the SCHOOL of ART of ROYAL DUBLIN SOCIETY for the Session ending 31st July 1856.

Receipts.	£	s.	d.	Disbursements.	£	s.	d.
Fees of pupils - -	238	7	4	Head Master's share of fees - - -	76	10	7
				Assistant Masters' do. -	75	13	9
				Assistant Masters, allowance to - - -	20	0	0
				Pupil-teachers, three at 10*l.* each - - -	30	0	0
				Attendants - - -	40	15	4
				Purchase of examples -	13	10	4
				Sundry small items -	4	0	5
				Gaslight - - -	15	0	5
				Repairs and alterations -	28	13	4
Balance due to the Society - - -	65	16	10	Coal and coke* - -			
				Advertisements* - -			
	304	4	2		304	4	2

* The cost of these items cannot be stated, in consequence of their having been included in the expenses of the general establishment.

(F.)

RETURN of the NAMES of STUDENTS who have obtained PRIZES or MEDALS in the DUBLIN SCHOOL OF ART, and of the WORKS (thus marked*) forwarded for the National Competition.

1.	Margaret White*	Outline ornament from the flat.
2.	Arthur Mayne*	„ from the round.
3.	Frances Hare*	Oranment shaded from the flat.
4.	Thomas Phelan	„ „
5.	Rosalie Ayre	„ „
6.	Arthur Mayne*	„ from the round.
7.	Seline Bushe	„ „
8.	Anna Wright*	Flowers from nature.
9.	Kate Seymour*	Figure painted from the flat.
10.	James Brown*	Modelling ornament from the cast.
11.	John Clark	„ figure from the cast.
12.	Kate Seymour*	Painting Landscape.
13.	Elizabeth S. White*	Surface design.
14.	John Woodhouse*	Modelling figure from the cast.
15.	Susan Banks	Model drawing.
16.	Richard Wilson	„
17.	Harriett E. Harman	Perspective.
18.	Selina Bushe	
19.	Richard Wilson	
20.	William Tough	
21.	Arthur Mayne	
22.	Henry Bailey	
23.	Nicholas Healy	
24.	Henry Brien	
25.	Arthur Mayne	Geometry.
26.	Richard Wilson	
27.	Henrietta E. Harman	
28.	Hester A. Harman	
29.	Arthur Mayne	Mechanical.
30.	Patrick Guilfoyle	
31.	Thomas Pemberton	

HONOURABLE MENTION.

Joseph Tracy.	Hester Ann Harman.
Elizabeth Haughton.	Eliza Smith.
Alice Fivey.	Rebecca Creach.
Arthur Mayne.	

Report of the Council of the Royal Zoological Society of Ireland, to the Lords of the Committee of Privy Council for Trade, for the Year 1856.

Referring to the Report of the last year, in which an account is given of the admissions, receipts, and expenditure of the Society since its foundation, the Council has to report on the progress of the Society during the year 1856, which has not been marked by any remarkable event, but, as will be seen by the annexed statements, shows useful and steady progress. The various works which were in hand at the time of the last Report have been completed, and the garden has been improved in all its departments.

During the year the Society has received several donations, the most remarkable of which were a very fine Chimpanzee, presented by Captain Adams, of H.M.S. "Scourge;" a large and handsome Bactrian camel, taken immediately after the battle of the Alma, presented by Wm. Carte, Esq., M.D.; and African sheep, herons, and crowned cranes, presented by his Excellency Lieutenant-Colonel Connor, Governor of the Gambia. The health of the animals generally has been remarkably good, and the losses, with the exception of the Chimpanzee just referred to, quite unimportant.

The Council has much pleasure in stating, that the conduct of the thousands of people in the gardens when admitted at one penny each is highly creditable to them; and they seem to be becoming daily more alive to the fact that the plants and animals there collected, being for the public recreation and instruction, should be protected by the public for its own sake. In fact they are, to use the words of an exalted personage, becoming "their own police;" and the moral effect of the well-disposed rebuking the idle when thoughtlessly teasing animals or breaking plants, produces excellent results.

In conclusion, the Council thinks that when it is recollected that 124,976 persons have, during the year, enjoyed the educational recreation the Zoological Garden affords, that it will be admitted the Society has fulfilled its object.

Return of Admissions for 1856.

Members' Free	2,997
Public at 2*s.* 6*d.*	228
„ at 1*s.* 3*d.*	18
„ at 6*d.*	9,859
„ at 3*d.*	2,107
„ at 1*d.*	108,767
Schools, free, about	1,000
	124,976

Appendix C.

REPORT OF ROYAL ZOOLOGICAL SOCIETY OF IRELAND.

CHARGE.

	£	s.	d.	£	s.	d.
Balance of last Account	56	0	10			
Government grant, 1¼ year	625	0	0			
Receipts at door	755	12	8			
Members' Subscriptions	222	5	0			
Incidental Receipts	14	1	8			
Young animals sold	10	0	0			
Balance	18	9	1¾			
				1,701	9	3¾

DISCHARGE.

Animals purchased	152	17	7½			
Food of Animals	521	0	7¾			
Incidental Expenses	195	18	9			
Salaries and Wages	172	4	0			
Buildings	656	18	3½			
Interest on Debenture	2	10	0			
				1,701	9	3¾

OFFICERS AND COUNCIL ELECTED 7TH MAY 1856.

President—Lord Talbot de Malahide.

Ex-Presidents.

His Grace the Duke of Leinster.
His Grace the Archbishop of Dublin.
Lieut.-Colonel Portlock.
The Marquis of Kildare.
Sir Philip Crampton, Bart.

Vice-Presidents.

D. J. Corrigan, M.D.
Lieut.-Colonel Larcom.
E. Hutton, M.D.
Sir Henry Marsh, Bart.
Robert Callwell, Esq.

Honorary Secretaries.

Robert Ball, LL.D., 3, Granby Row.
Hans Irvine, M.B., 1, Rutland Square.

Treasurer—Thomas Hutton, D.L.

Council.

Charles Benson, M.D.
F. W. Brady, Esq.
Lieutenant-Colonel Brown.
John Good, Esq.
Samuel Gordon, M.D.
Richard Griffith, LL.D.
G. W. Hatchell, M.D.
James S. Hughes, M.D.
John Lengtaine, Esq.
J. E. Martin, Esq.
Robert H. Moore, Esq.
B. G. M'Dowell, M.D.
M. J. O'Kelly, Esq.
J. Owen, Esq.
T. W. Warren, Esq.

REPORT FOR THE YEAR 1856, TO THE LORDS OF THE COMMITTEE OF PRIVY COUNCIL FOR TRADE, FROM THE COMMITTEE OF LECTURES, DUBLIN CASTLE, 31ST DECEMBER 1856.

Committee of Lectures.

Appointed on the part of Government:—

The Right Hon. Maziere Brady, M.R.I.A., Lord High Chancellor;
The Chief Secretary, or the Under Secretary in his absence;
Richard Griffith, LL.D., F.R.S.E., M.R.I.A.; and
Sir Robert Kane, V.P.R.I.A., F.R.S.;

On the part of the Royal Dublin Society:—

Lord Talbot de Malahide, M.R.I.A., V.P.R.D.S.;
The Right Hon. Francis Blackburne, LL.D., M.R.I.A., V.P.R.D.S.;
Frederick J. Sidney, LL.D., M.R.I.A.; and
The Rev. Joseph Galbraith, F.T.C.D., M.R.I.A.;

Robert Ball, LL.D., M.R.I.A., &c., Secretary.

THE Committee of Lectures presents the following Report of its proceedings during the year 1856:—

The Committee, being invested with the power to arrange the courses of lectures common to the Royal Dublin Society, and to the Museum of Irish Industry, has been mindful of the suggestion that the more scientific courses should be given at the former, and those on the application of science at the latter institution; and it accordingly approved of a programme calculated to carry out this view, in the session commencing in October 1856. *See* Abstract annexed (Table I.)

The Committee submits herewith a Tabulated Return (Table II.) of the twelve regular courses of lectures, which the funds placed at its disposal only enabled it to sanction in the provincial towns, being less than half the number of courses which were earnestly applied for (Table III.) This fact, taken in connexion with the satisfactory results of the lectures given, induces the Committee to reiterate, and still more strongly to urge its application for increased aid, as put forward at length in its Report of the last year.

Your Lordships, with a view to test the value of provincial lectures, having, by the Minute of the 24th July 1856 (Table IV.), directed, as an experiment, the holding of examinations at the termination of each course of provincial lectures, the Committee has to report, that although this measure was not brought forward until so late a period in the year that it was not possible to give such

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announcement of it as could sufficiently prepare the public mind for its due development, nevertheless great interest has been excited, some excellent answering obtained, and, on the whole, the Committee has every reason to believe that a perseverance in and an extension of the system will be attended with remarkable and valuable results. The method which has been adopted in carrying out these examinations has worked easily and well; much pains have been taken to make a proper selection of books to be given as premiums to the successful candidates at these examinations, and it is hoped that good educational results will arise from the dispersion of the scientific works in question.

The numbers of persons examined; the numbers to whom prizes were awarded; the names of persons to whom it is recommended that bronze medals be given, and the names of the examiners by whom the answers of the candidates were reported on are stated in Table II. The questions prepared for the several classes are also attached (V.)

Very great anxiety has been expressed for an early distribution of the prizes awarded, and it is understood that the local authorities of various institutions look to the public distribution of these prizes as a valuable stimulant to aid their objects.

The Committee having been consulted as to the advisability of the temporary employment of J. R. Kinahan, Esq., M.B., to do the duty of Professor Harvey during the absence of the latter, concurred in the proposed measure. Thus, Mr. Cardwell's arrangement with the deputation of the Royal Dublin Society on the 19th May 1854, as to the Committee being consulted in the appointment of professors, has been carried out in the only case in which the question has arisen.

In conclusion, the Committee annexes a Return, showing the attendance of its members at the ten meetings which have taken place during the year (VI.)

(By Order) ROBERT BALL, LL.D.

ABSTRACT of PROGRAMME of LECTURES to be given by the PROFESSORS of the DEPARTMENT OF SCIENCE AND ART, in the SESSION 1856–7, under the Direction of the Committee of Lectures.

In the Theatre of the Royal Dublin Society.

Twelve Lectures by each of the respective Professors at 4 o'clock P.M., on consecutive days to those herein-after named, Saturdays excepted.

Physics	to commence	on the	13th October 1856.
Chemistry	„	„	29th October „
Natural History (Zoology)	„	„	17th November „
Geology	„	„	3rd December „

These Lectures to be connected with, and followed by, courses of 20 Lectures each, to be given in the Museum of Irish Industry by the same Professors, under the direction of the Board of Trade.

Evening Classes at 8 o'clock P.M.

First 12 Lectures in each course free, under the direction of the Committee of Lectures.

In the Theatre of the Museum of Irish Industry.

Geology,	commencing	27th October.
Chemistry,	„	25th November.

In the Theatre of the Royal Dublin Society.

Physics,	commencing	2nd March 1857.
Botany,	„	4th May „

Twelve Lectures in the Botanic Garden, Glasnevin.

Botany: on such days in the month of June as may be fixed by the Royal Dublin Society's Council.

II.—Tabulated Return of the Results of Pr

Names of Places.	Names of Lecturers.	Subjects.	Appointed.	Paymen	
				Of Deposit.	T
Ballymena .	Prof. Davy, F.R.S. . . .	Chemistry .	28 May . .	29 July, £10	2
Bandon . .	Prof. Harkness, F.R.S.E. .	Geology . .	28 May . .	24 May, £10	2
Belfast . . .	Prof. Hodges, M.D. . .	Agricultural Chemistry.	7 January .	5 Jan., £5	1
Carlingford .	Prof. W. Barker, M.D. .	Electricity and Magnetism.	28 May . .	15 May, £10	1
Carlow . . .	Prof. W. Barker, M.D. .	Electricity and Magnetism.	14 October; *vice* Stoney, prevented by college duties.	15 May, £10	.
Carrickfergus .	John Barker, M.D. . .	Experimental Philosophy.	28 May . .	12 May, £10	1
Drogheda . .	W. Lover, M.D.	Natural Philosophy.	28 May . .	17 May, £10	2
Kinsale . . .	Prof. Jukes, F.R.S. . .	Geology . .	28 May . .	14 May, £10	2
Limerick . .	William Lover, M.D. . .	Natural Philosophy.	14 October; *vice* Shaw, prevented by college duties.	4 Aug., £10	.
Londonderry .	Prof. Dickie, M.D. . . .	Zoology . .	28 May . .	15 May, £10	2
Omagh . . .	E. W. Davy, M.B. . . .	Chemistry .	28 May . .	6 June, £10	2
Waterford . .	Prof. Melville, M.D. . .	Zoology . .	28 May . .	21 July, £10	1
Wexford . .	Prof. Sullivan, Ph. D. . .	Chemistry .	28 May . .	17 May, £10	

ES in IRELAND during the year 1856.

res ed.	Average Attendance.	Examinations. Number Attending.	Examinations. Number of Premiums.	Names of Examiners of Papers.	Medals. Names of Successful Candidates.	Observations.
ber ber.	250	17	10	Professor Blyth, M.D. . . .	Patrick Given.	
ber ber.	155	8	4	Rev. Prof. Haughton, F.T.C.D.	George Irwin.	
ril ay.	. .	. .	. .	. . . . .	. . . . .	A short course of Six Lectures given to Chemico - Agricultural Society; balance of grant of former years thus applied.
gust nber.	148	8	8	G. F. Shaw, LL.D., F.T.C.D. .	Michael Lyons.	
ess .	95	10	6	G. F. Shaw, LL.D., F.T.C.D. .	Richard H. Donnelly	Not finished at the close of year.
gust nber.	255	18	9	Prof. Stoney	William Mitchell.	
mber mber.	243	9	7	G. F. Shaw, LL.D., F.T.C.D. .	William D. Bruce.	
ne ly.	90	. .	. .	. . . . .	. . . . .	Given before the examination was arranged.
ess .	125	6	6	G. F. Shaw, LL.D., F.T.C.D. .	Susannah Lecky .	Not finished at the close of year.
mber ober.	272	14	9	J. R. Kinahan, M.B. . . .	Thomas J. Willans.	
ober ber.	117	12	7	Prof. Blyth. M.D.	Seaton F. Milligan.	
ober nber.	265	32	10	J. R. Kinahan, M.B. . . .	Anna D. Peet.	
ber ber.	150	9	1	Prof. Blyth, M.D.		

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III.

NAMES of PLACES from whence applications have been received for LECTURES, but which the COMMITTEE had not means to comply with:—

Aughnacloy.	Parsonstown.
Belfast.	Portlaw.
Clonmel.	Skibbereen.
Cork.	Sligo.
Dungannon.	Strabane.
Killman.	Tullamore.
Kilrush.	

IV.

MINUTE on the REPORT of the COMMITTEE of LECTURES.

THE Committee of Lectures has recommended in its Annual Report that the vote for provincial lectures should be doubled, or increased from 500*l.* to 1,000*l.*

The Board of Trade (Department of Science and Art) is unable to comply with the request in its present form; as, beyond the desire manifested for the lectures, it cannot show any results which prove that the public derive decided advantages from the course of lectures given. The Board is, however, willing to incur a certain expenditure to have their results tested, by the examination of the pupils who attend the lectures.

With this view, it is suggested that at the close of each course examination papers should be issued to the persons who attended it; and that after these papers have been answered, they should be transmitted to Dublin for the purpose of being referred to examiners.

To each pupil who comes up to certain standard of proficiency in the examination, the Committee of Lectures would be empowered to give a prize of the value of 10*s.*; and when he showed peculiar excellence, a bronze medal of the Department would also be given.

The examination papers carrying the bronze medal would be sent up to London for the inspection of the Department.

With the view of trying this experiment, and testing the results of the lectures, the Board will provide a sum not exceeding 150*l.* for prizes and examiners, and a further sum of 50*l.* to Dr. Ball for superintending the experiment.

Leaving to future consideration the exact manner in which the above sum of 150*l.* should be distributed, I would suggest that the examiners should be paid a sum of 3*l.* 3*s.* for all the papers sent up from each course of lectures. If the experiment be successful, it would be well worthy of consideration in a future year how the lecturer should be made to participate in the results of his teaching; for a permanent success will best be secured by making it the interest of the master, as well as of the pupil, to produce the greatest good from the instruction given. Should the Committee desire, out of the above sum of 150*l.*, part might be expended, even this year, in encouraging the lecturers. For example, 20*s.* might be given for every four persons taking the 10*s.* prizes; and for every pupil who took a Department medal, 20*s.* might be awarded.

The ultimate expenditure of such a scheme as is proposed can always be regulated by the amount of vote sanctioned by the Board; while the Committee of Lectures will be able to regulate by the standard of excellence which it proposes upon the examination papers.

(Signed) LYON PLAYFAIR.

Signed, as approved by Lord Stanley,
24th July 1856.

V.

Questions for Examination of the Class which attended Lectures on Experimental Philosophy, in Carrickfergus, August 1856.

John Barker, M.B., Lecturer.

1. What are the essential properties of matter?
2. Give examples of very minute division of matter, in natural objects, and in the arts.
3. Matter exists in three states,—what are they?
4. Give an illustration of matter in a gaseous state,—what experiment will show that it possesses weight?
5. What is the attraction of cohesion? Cite an experiment illustrative of its force.
6. Mention what chemical change takes place in all ordinary combustions, and give examples of combustion in oxygen gas, and the products resulting.
7. What effect has breathing on the air?
8. State the composition of the air and the relative uses of its different component parts.
9. On what does the illumination of flame depend?
10. In what consists the quantity and intensity of light?
11. Explain the changes that take place in the lower, middle, and upper portions of the flame of a candle.
12. Under what circumstances does light decompose carbonic acid?
13. Detail the sources of heat.
14. What is the most important effect of heat?
15. How is a thermometer made?
16. Is the law of expansion by heat universal?
17. Do all bodies expand equally by heat? Give examples.
18. Do solids and fluids conduct heat equally? What are the experiments to which you would refer to illustrate this?
19. Give examples of good and bad conductors of heat.
20. State the different ways by which heat is communicated.
21. What is the usual cause of winds?
22. Explain the causes of the trade winds and gulf stream, and describe them.
23. What is latent heat? Give an illustration.
24. Why is it that we cannot heat water in an open vessel to a greater temperature than 212 degrees?
25. Are the temperatures of the melting points of substances always the same? Are the boiling points? What influence has pressure upon them?
26. What are the uses of evaporation in organic and inorganic nature?
27. The radiation of heat varies according to the nature of the surface. How so?
28. Explain the cause of dew and hoar frost.
29. About what bulk will a cubic inch of water occupy, when converted into steam?
30. Explain the construction and use of the governor in a steam-engine.
31. What is the eccentric in a steam-engine?
32. What is the use of the fly-wheel, and under what circumstances is it not found in a steam-engine?
33. What is meant by the duty and power of a steam-engine?
34. What is the direction of a freely suspended magnetic needle?
35. What is the dip of the magnetic needle?
36. What is the variation?
37. How can we find out if a substance is positively or negatively electric?
38. Describe some of the most important forms of galvanic batteries.
39. How are electrotypes made?
40. Water is decomposed by galvanic action, into what substances, and what are their proportions?

Appendix C.

PROVINCIAL LECTURES, IRELAND.

41. What was Oerstead's discovery relative to the influence of an electrical current on a magnetic needle?
42. What is a galvanometer? How constructed?
43. The power of giving electrical shock exists in some animals; describe them.
44. How are electro-magnets made?
45. Describe some of the effects of a powerful galvanic battery.
46. How are magnets made?
47. What is meant by an induced electric current?
48. Explain the construction of *Ruhmkorff's* coil, and detail some of its effects.

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on ELECTRICITY and MAGNETISM in CARLINGFORD, in the months of August and September 1856.

WILLIAM BARKER, M.D., Lecturer.

1. What is the derivation of the word electricity?
2. From what sources is electricity obtained?
3. How do we ascertain the pressure of free electricity?
4. What are the simplest forms of electroscopes?
5. How do we ascertain the species of electricity?
6. What are the theories of Dufay and Franklin?
7. How is an electrifying machine constructed, and what is the theory of its action.
8. What is meant by inductive electricity?
9. Explain the electrophorus and the theory of its action?
10. What is the Leyden jar, and what is the use of the metallic coating on its surfaces?
11. What are the proofs of the identity of lightning and electricity, and what is the cause of thunder?
12. What are the principles on which lightning conductors are employed, and what proofs have we of their utility in affording protection during thunder-storms?
13. What precautions should be taken by the inhabitants of dwelling-houses during thunder-storms?
14. What is the voltaic battery, and what are the theories respecting the electricity produced by it?
15. What are the differences between common and voltaic electricity?
16. How are bodies classified with respect to their electrical relations?
17. How do we prove the mutual relation of substances by the voltaic battery?
18. What is the principle employed in electrotyping?
19. State the method used for copper, silver, or gold electrotyping?
20. How is magnetism distributed in a magnetic bar?
21. What is meant by the variation of the compass?
22. Is the variation of the compass the same at all times and in all places?
23. What is the magnetic meridian?
24. What early proofs have we of the connexion between magnetism and electricity?
25. State the facts first observed by Oerstead respecting a connexion between magnetism and electricity?
26. How has this discovery been applied to the telegraph?
27. What is meant by inductive currents?
28. Explain the different forms of the printing telegraph?
29. State some other practical applications of electro-magnetism?
30. What are the methods of preparing artificial magnets?
31. What are the differences between soft iron and steel with respect to magnetism?

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on CHEMISTRY in BALLYMENA, in the month of October 1856.

EDMUND DAVY, F.R.S., &c., Lecturer.

1. Explain the differences between mechanical and chemical change in bodies, and illustrate by some examples.

2. What are the three great classes of ponderable matter belonging to our globe?

3. What is a simple or elementary body, and how many are there at present known? Give an example of a primary and a secondary compound.

4. State the chief objects of chemistry.

5. What is the most general law or leading principle of chemistry to which chemical changes are referred, and how far does its influence extend?

6. State the points of difference between chemical attracton and the attraction of gravitation and cohesion.

7. Define chemical attraction or affinity, and state two instances of its operation, viz.:—one of chemical combination, and the other of chemical decomposition.

8. State what you understand of what is called the atomic theory and the doctrine of equivalents, and wherein they differ from each other.

9. Explain the law of definite and multiple equivalents, and state one or two examples. State also what is the equivalent of a compound body.

10. State some of the uses to which the knowledge of equivalents can be applied in practical chemistry.

11. Explain the law of simple or single elective affinity, and state some of its important applications to arts and manufactures.

12. Explain and illustrate by example the law of double elective affinity, and point out its applications to the arts.

13. Explain, and illustrate by example, the law of intermediate or disposing affinity, and refer to some of its useful applications.

14. State the principal sources of heat, and some facts which prove its vast importance in the operations of nature and art.

15. State some of the most remarkable changes which heat produces in bodies.

16. State the law of the uniformity of the rate of the expansion of gases and vapours by heat.

17. State some of the uses of the expansion of gases, fluids, and solids by heat.

18. Explain how the unequal expansion of different metals, by heat, has been applied to improve our clocks and watches.

19. State and explain some of the apparent exceptions to the law of the expansion of bodies by heat. Notice the remarkable peculiarities in the case of water and ice, and their importance in the economy of nature.

20. Explain the nature of evaporation, the chief circumstances that influence it, and its importance, especially in the external world.

21. Explain the processes and theory of distillation and sublimation, and state some of their useful applications.

22. State the principal methods of obtaining oxygen and hydrogen, their chief properties and compounds. State some facts which prove their vast importance, especially of oxygen, in the economy of nature and art.

23. State the composition of water by weight and by volume, and the methods by which it is formed from and resolved into its elements.

24. State some of the principal properties and uses of water, including the forms it assumes under different temperatures, its increase of volume when converted into steam, and some of the uses of steam.

25. State the circumstances under which the boiling point of fluids is greatly reduced, and the useful applications of such facts.

26. In what combinations does chlorine occur in nature, by what methods it is obtained? State its chief properties and uses, and the views entertained of its agencies in bleaching and removing offensive odours.

27. State the usual method of making muriatic acid gas, and the common muriatic acid of commerce, the composition of the gas by volume, the circum-

stances under which its elements combine. State some of the leading properties and uses of muriatic acid, also the chief impurities in the acid of commerce, and the means of detecting them.

28. State the usual methods of obtaining nitrogen, its chief properties, and some of its uses.

29. State the methods of obtaining ammonia and its solutions, their chief properties, composition, and uses.

30. State how nitre is obtained, its chief properties and uses.

31. State how nitric acid is obtained, its chief properties, composition, and uses.

32. State how gun cotton and gun wood are obtained, their chief properties, uses, and elements.

33. State the principal known varieties of carbon, and their chief uses.

34. State some of the compounds of carbon with oxygen, as carbonic oxide and carbonic acid, the methods of making them, their chief properties and composition, and show how the doctrine of multiple equivalents is illustrated when they are obtained from oxalic acid.

35. State some of the compounds of carbon and hydrogen, as carburetted hydrogen and olefiant gases, their composition and uses.

36. State from what sources sulphur is obtained, its chief properties and uses; also its principal compounds with oxygen, viz.,—sulphurous and sulphuric acids. State how they are obtained, their chief properties, uses, and composition.

37. State how phosphorus is obtained, its chief properties and uses. State how phosphoric acid is made, its chief properties and composition, and refer to its existence and uses in the different kingdoms of nature.

38. State the composition of the atmosphere by weight and measure. Illustrate the principal chemical agencies of its constituent parts by a reference to particular instances.

39. Explain what is meant by the *diffusive power of gases.* State the law of diffusion and its important application to the atmosphere.

40. State what is known respecting the renovation of the atmosphere, and to what agencies it is referred.

Questions for Examination of the Class which attended Lectures on Chemistry in Omagh, during the month of October 1856.

Edmund William Davy, M.B., Lecturer.

1. Explain the difference between mechanical and chemical change, and illustrate by an example.

2. Define chemical affinity or attraction, and state wherein it differs from cohesion or cohesive attraction.

3. What is meant by single and double elective affinity? Give an example of each, and show their importance in some of the useful arts.

4. In describing a substance, into what two classes do we generally divide its properties? and explain the meaning attached to each class.

5. Define what is meant by a simple and a compound substance. Into what two classes have the simple substances been divided?

6. State some of the methods of procuring oxygen, and enumerate some of its most striking properties.

7. What are the three different classes of compounds which oxygen produces by chemically uniting with different simple substances?

8. What are all the ordinary forms of combustion, and wherein does respiration resemble them?

9. From what source is hydrogen usually obtained? Explain how; and mention the most characteristic properties of that substance.

10. What is the exact composition of water by weight?

11. When a jet of hydrogen gas is burned in an atmosphere of common air, what is the product of its combustion, and what is remarkable about the flame?

12. What is meant by the term hardness as applied to water, and on the presence of what substance does it chiefly depend in general? and how may the hardness be more or less completely removed?

13. From what source, and by what means is nitrogen usually obtained for experimental purposes? State its most characteristic properties.

14. What is the composition of pure atmospheric air by weight and by volume?

15. What is meant by the diffusive power of gases? Show its great importance in nature?

16. What law is found to govern the rate of the diffusion of different gases?

17. What important compound does nitrogen form with oxygen? In what state does it occur in nature? and how is it obtained as employed in its useful applications?

18. Mention some of the most important uses of nitric acid in its free state, and also when combined with different bases.

19. What important compound does nitrogen form with hydrogen, and from what source is this compound now chiefly obtained?

20. What very important office does the ammonia which exists in minute quantity in the atmosphere and its soil perform?

21. Mention some of the different forms of carbon found in nature, and prepared by artificial processes.

22. From what substance, and whence chiefly derived, do plants assimilate or take up the carbon which forms so large a portion of their structure?

23. Explain why carbon is so admirably adapted to form the basis of all our different kinds of fuel for producing artificial heat and light.

24. What is the most important compound of carbon and oxygen? State some of its chief uses in nature and art.

25. Mention some of the most useful and best known compounds of carbon, hydrogen, and oxygen, and state what is remarkable about some of them, as to their composition.

26. From whence is coal derived? Enumerate some of the more valuable substances produced in its composition by heat in close vessels.

27. What are the properties and composition of the fire and choke damp of coal mines?

28. On what principles depend the construction of the safety lamp of Sir H. Davy?

29. How is chlorine generally obtained? Mention its most striking properties.

30. What is the most abundant and important compound of chlorine in nature? Enumerate some of its most important uses in nature and art.

31. Wherein does chlorine resemble oxygen?

32. How is chlorine employed, both as a bleaching agent, and as a means of producing white patterns on coloured grounds?

33. From what two sources is the sulphur obtained which is so extensively used in the arts? Explain how.

34. What is the most important compound of sulphur? Explain how it is obtained, and mention some of its most characteristic properties.

35. From what source is phosphorus obtained? Explain how, and enumerate some of the most striking properties of that substance.

36. State some facts which show the importance of phosphoric acid to animals and plants.

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on ZOOLOGY in LONDONDERRY, in the month of October 1856.

GEORGE DICKIE, M. D., Lecturer.

1. Why are certain animals called vertebrate? Enumerate the classes comprehended under this head.

2. State the orders of the mammalian class, and give examples of each.

3. Why are certain animals called cheiroptera? State their manner of life, and the general character of their teeth.

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4. Mention examples of domesticated animals belonging to the orders of rodents, carnivora, pachydermata, and ruminantia.

5. State in a general way the differences in the teeth and digestive canal of an herbivorous and carnivorous animal.

6. What are the peculiarities in the external and internal parts of the cetacea which fit them for life in water?

7. Name certain animals in which there appears to be a relation between external appendages of the head and the presence or absence of certain teeth.

8. State the difference between the foot of a horse and that of an ox.

9. Compare the wing of a bat with that of a bird.

10. Mention birds which want the power of flight, and state in what respects they differ from ordinary birds.

11. State the differences between mammals, reptiles, and fishes.

12. Mention the orders of the reptile class.

13. What are the characters of the ophidian order?

14. In what respects do whales differ from fishes?

QUESTIONS for EXAMINATION of the CLASS attending the COURSE of LECTURES on GEOLOGY, delivered in BANDON, in October 1856.

ROBERT HARKNESS, F.R.S.E., Lecturer.

1. What are the objects of geology?

2. What are the causes which modify the external surface of the earth?

3. How is mineral matter arranged by water?

4. What are the effects which volcanoes produce on the surface of the earth?

5. What is meant by the term *stratum*, and what are the features which mark this form of structure?

6. Describe unconformability, and what does this indicate?

7. What is the general form of the particles which enter into the composition of such rocks as result from the action of water?

8. What is the usual form of the particles which compose volcanic rocks?

9. What is meant by the term fossils, and of what do these consist?

10. By what means do geologists divide the sedimentary rocks into groups?

11. What was the nature of the climate of the Pleistocene, or Boulder epoch?

12. Of what does coal consist, and to what geological formation do the coal beds of the United Kingdom belong?

13. Name the oldest sedimentary deposits, and what fossils occur in these?

14. What are the features which mark Plutonic rocks?

15. How have the Metamorphic groups of rocks originated, and give an instance of one of these rocks?

16. What is the nature and origin of mineral veins?

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on NATURAL PHILOSOPHY in DROGHEDA, in the months of October and November, 1856

WILLIAM LOVER, M.D., Lecturer.

1. How does attraction of cohesion differ from attraction of gravitation?

2. How does mass differ from volume?

3. Can two bodies have the same volume and not the same mass? Give an example.

4. Does weight exist in a body, as when we say an ounce of lead?

5. Two plumb lines are not parallel—why?

6. Why is a cubic inch of wood lighter than a cubic inch of lead?

7. We say that gravitation is inversely as the square of the distance, what does this signify?

8. The spring-balance and pendulum prove that weight is less at the Equator than in Greenland—why?

9. Why will not the common beam-balance prove this fact?

10. Why does not the earth fall to the sun as a stone does to the earth?

11. What experiment proved that two forces acting in different directions produced an intermediate result?

12. In that experiment the intermediate motion was in a straight line, why is not the earth's orbit, produced by gravitation and centrifugal force, a straight line?

13. If a body move at one period twice and at another three times as fast, what will be the increase of the centrifugal force?

14. Why does the equestrian in the circus lean towards the centre when the horse is in rapid motion?

15. What experiment with three revolving balls proved that weight is less at the Equator?

16. Why does a spinning top feel lighter when in rapid motion on the hand?

17. What is understood by the term inertia?

18. What prevents perpetual motion in machinery?

19. What proportion does pressure of a solid on its base bear to its weight?

20. What proportion of the weight of a mass of water presses on the base of he vessel—suppose a square inch?

21. In which direction do liquids and gases press?

22. What produces upward pressure?

23. What proportion does it bear to the downward pressure?

24. Upward pressure is the principle of specific gravity—what does this term signify?

25. How do we find the specific gravity of a solid, such as a lump of gold, by the hydrostatic balance?

26. What is the specific gravity of gold?

27. What important metal is heavier than gold, and what is its specific gravity?

28. Explain the principle of the hydrometer for testing the specific gravity of quids.

29. What experiment proved the upward pressure of air?

30. How does momentum differ from velocity?

31. What causes such a small weight as an ounce to give a severe blow in falling through a great space?

32. Through what space does a body fall in the first second?

33. Through what space in the second second by its acquired force?

34. How could an ounce weight and a pound be made to have the same momentum?

35. As distance travelled over is a measure of speed, how much farther should the ounce move than the pound in the same time?

36. On the principle of momentum depends the character of the lever—what are the names of the three points connected with every lever?

37. How do the three orders of lever differ from each other?

38. If we wish to raise a weight of 1,000 lbs. by a force of 50 lbs., how much longer should one arm of the lever be than the other?

39. Why does this difference in length produce such an effect?

40. If we had a power or force of 20 lbs. and a lever arm of 40 inches, what should be the length of the opposite arm to raise 400 lbs.?

41. What is the use of a bent lever?

42. If the power or force act obliquely on a lever, how do you calculate the length of the arms?

43. The wheel and axle form a continuous lever—what does this signify?

44. Describe how the crank ceases to be a lever, and arrives at two dead points.

45 How did Watt overcome the dead points in the steam-engine?

46. What proportion does the crank of the steam-engine bear to the length of the cylinder?

47. Describe the principle of the eccentric which moves the valve.

48. Why does the slide valve excel the old circular valve?

49. Watt's steam-engine was derived from Newcomen's atmospheric steam-engine—why called atmospheric?

50. How did Watt prevent the steam from escaping above the piston at the cover?

51. In a condensing steam-engine, what becomes of the waste steam?
52. What object is gained by this process?
53. Why is the pump which empties the condenser called the air-pump?
54. What is the use of the cold water pump?
55. Who first used steam in a cylinder for obtaining a vacuum?
56. How did Savery obtain a vacuum by steam in his engine?
57. What is the use of the governor in the steam-engine?
58. Upon what principle does it act?
59. How is the factory connected with the steam-engine?
60. Why is there no governor in the locomotive and marine engines?

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on NATURAL HISTORY in WATERFORD, in the months of October and November 1856.

A. G. MELVILLE, M.D., Lecturer.

1. State the principal distinctions between inorganic and organic bodies.
2. State the principal distinctions between plants and animals.
3. What is meant by the term analogy? Give examples of analogical organs.
4. What is meant by the term homology? Give examples of homological organs.
5. Illustrate the meaning of the term *type* by examples.
6. What is the structure of a cell, and how may it be multiplied?
7. Describe the constitution of the blood as revealed by the microscope.
8. Describe the microscopic structure of bone.
9. Describe the phenomena of the diffusion of liquids of different densities through an intervening membrane.
10. Mention the various sources of the demand for food in the higher animals.
11. Mention the different classes of materials used as food, and state their respective uses in the animal economy.
12. State the respective uses of the different constituents of the gastric juice in effecting the solution of the food.
13. Mention the various channels by which the soluble constituents of the food are conveyed into the blood, the ingredients which they respectively absorb, and the special uses of the lymphatic and lacteal systems of vessels.
14. State the various uses of oxygen in the animal economy.
15. State the essential structure of a gland, and define the terms, secretion and excretion.
16. Mention the products into which the dead tissues are resolved, and the organs by which they are respectively removed.
17. Describe the phenomena of respiration, and the proximate sources of the carbonic acid and water evolved at the respiratory surfaces.
18. In what organ are the albuminous matters of the food converted into blood-albumen?
19. State the course of the circulation in man.
20. What are the component parts of a nervous system? State their respective uses.
21. Mention the functions of the roots of the spinal nerves.
22. Describe the constitution of the axis of the nervous system in the vertebrate animals.
23. Describe the nervous actions concerned in the act of swallowing.
24. Enumerate the higher or special senses.
25. Describe the structure of the eye in man.
26. State the uses of the various parts of the eye in man.
27. How do we acquire our notions of the solidity and relief of bodies?
28. Mention the simplest condition of an organ of hearing.
29. Give an idea of the structure of the ear of man.
30. Give examples of the dermal and visceral skeletons in fishes.
31. What is the composition of the vertebral bony segment? (ideal vertebra.)
32. Show how the skull may be resolved into a series of vertebral segments.
33. What is the meaning of the terms, species, genus, order, class, type?

34. Enumerate the primary types of the animal kingdom, and mention their principal characters.

35. Give an account of the phenomena of metamorphosis observed in insects.

36. Mention the subdivisions of the vertebrate type, and give their principal characteristics.

37. Mention some of the peculiarities of structure in the skeleton of tortoises.

38. What are the peculiarities respectively characteristic of the different families of the quadrumana?

39. Mention the principal characters which distinguish man from the higher quadrumana.

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on CHEMISTRY in WEXFORD, during the month of October 1856.

WILLIAM K. SULLIVAN, Ph. D., Lecturer.

1. What are we to understand by a simple body?
2. What are we to understand by a compound body?
3. Mention the most characteristic properties of common oxygen.
4. Mention the most charactertstic properties of hydrogen.
5. Mention the most characteristic properties of nitrogen.
6. Mention the most characteristic properties of chlorine.
7. Mention the most characteristic properties of sulphur.
8. Mention the most characteristic properties of common phosphorus.
9. What is meant by an allotropic state?
10. Mention the most striking examples of allotropism.
11. State the composition of water by weight and by volume.
12. Mention the compounds which nitrogen forms with oxygen, beginning with that containing least oxygen.
13. Describe what takes place when nitric acid is poured upon metallic copper.
14. What takes place when sodium is thrown upon water?
15. What very important substance is composed of nitrogen and hydrogen?
16. Mention the most important compounds of carbon and oxygen.
17. Of what is the atmosphere composed? and what is the composition of atmospheric air by weight and volume?
18. Of what does common salt consist?
19. What are the most important compounds of sulphur with oxygen?
20. State the chief laws which have been established with regard to the combination of bodies by weight.
21. Define the law of gaseous combination.
22. How are compound bodies classified?
23. Define what is meant by electro-positive and electro-negative bodies.
24. Define what is meant by a base, an acid, and a salt.
25. What is meant by the expressions *single elective affinity*, and *double elective affinity*?

QUESTIONS for EXAMINATION of the CLASS attending the Course of LECTURES on ELECTRICITY and MAGNETISM, delivered in Carlow, in December 1856.

WILLIAM BARKER, M.D., Lecturer.

1. Explain the action of the electrifying machine by the theories of Dufay and Franklin.
2. What do you mean by the positive and negative conductors?
3. What is the meaning of the term induction?
4. What is the supposed use of amalgam in exciting the machine?
5. Explain the theory of the Leyden jar.
6. Why are the terms statical and dynamical electricity employed, and what do we mean by speaking of currents of electricity?
7. How do we test the presence of minute quantities of electricity?
8. Explain the terms quantity and intensity.
9. What are the sources of electricity?

Appendix C.

PROVINCIAL LECTURES, IRELAND.

10. What was the origin of the discovery of voltaic electricity? and what was Volta's hypothesis?
11. What is the chemical theory of voltaic electricity?
12. Describe the construction of the voltaic battery; and mention the various forms employed.
13. What is the theory of the electrotype?
14. What metals are most susceptible of acquiring magnetism?
15. Where are the magnetic poles of the earth placed?
16. How do we prepare artificial magnets?
17. How is magnetism distributed in a magnetized bar?
18. What do we mean by the magnetic meridian?
19. What is the variation of the compass, and is it constant?
20. Describe the first experiment in electro-magnetism.
21. What is the direction of the electro-magnetic force?
22. How is an electro-magnet made?
23. How is electro-magnetism applied to the telegraph?
24. What principles are applied to the construction of the printing telegraph?

QUESTIONS for EXAMINATION of the CLASS which attended LECTURES on NATURAL PHILOSOPHY, in the ATHENÆUM of LIMERICK, in the months of December 1856 and January 1857.

WILLIAM LOVER, M.D., Lecturer.

1. What is the definition of a force?
2. State some of the forces of nature?
3. Prove that there is no absolute rest in nature; and what is relative rest?
4. What is understood by the terms inertia of rest and motion?
5. A force is generally counteracted by another force; what is the opposing force to attraction of gravitation?
6. What is the opposing force to attraction of cohesion?
7. What is the opposing force to action, and what proportion do they bear to each other?
8. How was the fact proved by experiment?
9. What force is opposed to compressibility?
10. How did Perkins prove that water is compressible by sinking a cylinder, with a piston, into the sea?
11. The pressure of gases is in the inverse ratio of their volume, explain this law.
12. When air is compressed it is said to be condensed; what does condensed steam signify?
13. Air and other gases are condensed by the force-pump; explain how it differs from the air-pump.
14. Great cohesion produces tenacity; which is the most tenacious body in nature?
15. What is capillary attraction?
16. What causes the surface of a liquid to be level?
17. The liquid level is not a straight line, but a curve,—why?
18. What caused the earth to bulge out at the equator?
19. Why has it not continued to give way in that direction?
20. A large grinding-stone may fly to pieces by rapid motion, what force would effect this, and what force would be overcome?
21. What model illustrated the earth bulging out at the equator?
22. Centrifugal force increases with the square of the velocity; explain this law.
23. A locomotive engine may move off a curved rail; what is the remedy?
24. Explain the mechanism of the centrifugal pump, and how it acts.
25. What are the parts of a common pump, and explain the position of its valves.
26. Who invented the common pump, and at what time and place?
27. How did the ancients explain the pump?

28. Who discovered the true cause of its action?
29. To what height will a common pump raise water above the level?
30. How place a longer pump so that it would stand at the proper height?
31. Why did the inventor of the theory use mercury in the bent tube to prove the height to which water would rise in a pump?
32. Explain how a column of mercury proves that the pressure of the air is nearly 15 lbs. on the square inch at the level of the sea.
33. What experiment proved that atmospheric pressure influenced the boiling point?
34. Who first showed that boiling water can become hotter than 212°, and how did he operate?
35. What are the highest and lowest points in the barometer?
36. To what part of a steam-engine is the barometer applied, and for what purpose?
37. In 1698 Savery raised water by steam, describe his process, and the cause of his failure.
38. Newcomen followed Savery, and used a beam with arch-heads at its extremities, for what purpose?
39. In making a model of such a beam, how make the arch-heads the correct size?
40. Why was Watt's first steam-engine called single-acting, in contradistinction to the present double-acting steam-engine?
41. If a beam were not arranged with its fulcrum in the centre, a small weight at the end of the long arm can balance a greater weight on the short arm, upon what principle?
42. If the arms be unequal in length, what is the general rule for finding the proportion between weight and power?
43. What is a compound lever?
44. Explain the model which proved that wheels and pinions are modified compound levers?
45. In machinery wheelwork often acts on the decimal principle; explain this?
46. State, in general terms, how the pressure of the gas moves the gas metre, and how that movement is changed to very slow motion, and ultimately registered.
47. In a common clock the falling weight moves a train of wheels and pinions ending in the escapement; explain how it acts on the pendulum.
48. Explain how the fusee of a watch unwinds the chain with equal speed, for the spring is a variable force.
49. The pendulum alters by heat and cold, how did Harrison remedy this defect?
50. Upon what principle did Arnold make the compensation-balance for a watch?
51. Upon what principle did Graham make the mercurial pendulum?
52. What advantage has the wheel barometer?
53. What is a Torricellean vacuum?
54. How did Shalder obtain a vacuum in a pump without a piston?
55. What is the use of the air-vessel in a force-pump?
56. How do I prevent a force-pump from bursting by frost?
57. In Bramah's hydrostatic press, if the small piston be six times less than the second piston, how much increase of pressure would be gained, without calculating the handle as a lever?
58. The inertia of rest acts injuriously in common pumps; explain this?
59. How much greater is the volume of steam than water?
60. How does collapse differ from bursting?

Appendix C.

PROVINCIAL LECTURES, IRELAND.

VI.

ATTENDANCE OF THE COMMITTEE OF LECTURES, FOR THE YEAR 1856.

30th January 1856.

The Right Hon. Maziere Brady, Lord Chancellor, in the Chair.
Richard Griffith, Esq., LL.D.
Sir Robert Kane, Director of the Museum of Irish Industry.
Lord Talbot de Malahide.
Frederick J. Sidney, Esq., LL.D.

Robert Ball, LL.D., *Secretary*.

13th February 1856.

The Right Hon. Maziere Brady, in the Chair.
Richard Griffith, Esq.
Sir Robert Kane.
Lord Talbot de Malahide.
Frederick J. Sidney, Esq.
Rev. J. Galbraith.

Robert Ball.

27th February 1856.

The Right Hon. Maziere Brady, in the Chair.
Sir Robert Kane.
The Right Hon. Francis Blackburne.
Frederick J. Sidney, Esq.

Robert Ball.

17th May 1856.

The Right Hon. Maziere Brady, in the Chair.
Richard Griffith, Esq.
Sir Robert Kane.
Lord Talbot de Malahide.
The Right Hon. Francis Blackburne.
Frederick J. Sidney, Esq.
The Rev. Joseph Galbraith.

Robert Ball.

28th May 1856.

The Right Hon. Maziere Brady, in the Chair.
Lieutenant-Colonel Larcom.
Sir Robert Kane.
The Right Hon. Francis Blackburne.
Frederick J. Sidney, Esq.
The Rev. Joseph Galbraith.

Robert Ball.

12th July 1856.

The Right Hon. Maziere Brady, in the Chair.
Lieutenant-Colonel Larcom, Under Secretary.
Richard Griffith, Esq.
Sir Robert Kane.
The Right Hon. Francis Blackburne.
Frederick J. Sidney, Esq.

Robert Ball.

20*th August* 1856.

The Right Hon. Maziere Brady, in the Chair.
Lieutenant-Colonel Larcom, R.E., Under Secretary.
Sir Robert Kane.
The Right Hon. Francis Blackburne.

Robert Ball.

14*th October* 1856.

Lord Talbot de Malahide, in the Chair.
Richard Griffith, Esq.
Sir Robert Kane.
The Rev. Joseph Galbraith.

Robert Ball.

26*th November* 1856.

The Right Hon. Maziere Brady, in the Chair.
Frederick J. Sidney, Esq.
The Rev. Joseph Galbraith.

Robert Ball.

31*st December* 1856.

The Right Hon. Maziere Brady, in the Chair.
Sir Robert Kane.
Frederick J. Sidney, Esq.
The Rev. Joseph Galbraith.

Robert Ball.

REPORT of the IRISH NORMAL LACE SCHOOL, 76, Harcourt Street, Dublin, for the Year ending 31st December 1856.

Committee:—

The Countess of Erne. | The Lady Fanny Howard.
Mrs. Horsman.
The Chief Secretary for Ireland.
The Under Secretary for Ireland.
Miss Elizabeth Lloyd,—Hon. Treasurer.
Miss Bruce,—Hon. Secretary.
Matron:—Miss Andrews.
Art Teacher:—Miss Ashworth.
Valenciennes Lace Teacher:—Catherine Luddon.
English Lace Teacher:—Anne Lavin.

IN submitting the following report, the Committee beg to call attention to the change observable in the class of pupils applying for admission to the school. From the time when it was first opened in 1851 up to the close of the year 1854, the pupils were, with scarcely an exception, placed in the school by lady patronesses who either desired to establish country lace schools under their tuition, or to secure for their *protégées* what they expected would prove a remunerative employment. They were sent *solely* for the purpose of learning the lace-making (every other kind of instruction that they received being considered quite secondary to it), and when this was acquired they were removed. Since 1855 the Committee, having received Parliamentary aid, were enabled to enlarge the education given in the school by appending to it a school of art, and appropriating a greater portion of the pupil's time to the elementary instruction. The paying pupils now in the school are, with only two exceptions, sent by their parents—persons of respectability, who willingly pay the required sum for their children, and to this class all the present applicants for admission belong.

The number of pupils who have passed through the school in the course of the past year was twenty-three. Of these—

15 remain in the school.
2 left as elementary teachers.
1 left as lace and elementary teacher.
1 left from ill health.
1 removed by her patroness, on the ground of expense.
1 removed by her parents, her services being required at home.
1 removed by her parents, because obliged to learn lace-making.
1 died.
4 day pupils attended during part of the year.

Appendix C.

NORMAL LACE SCHOOL, DUBLIN.

Of the three who left as teachers, the Committee have received most satisfactory reports, both as regards their efficiency and their conduct.

The Committee regret to be obliged to report, that whilst the drawing classes are steadily increasing, and the advantages of the general education and moral training are more fully appreciated than heretofore, both by the pupils and their parents, the lace-making has ceased to be any attraction to the school. The lace made by the girls is excellent in colour and make, possessing the crisp firmness which is a distinctive qualification of good lace; but the lace-making is not sought either by the pupils themselves or by their parents for them. Of the pupils applying for admission, none have come with a view to learn the lace-making; some have consented to learn it rather than relinquish the other advantages of the school; several have been deterred from entering in consequence of the necessity for learning it. Only one application for a lace teacher has been made, whilst there have been several for teachers of the elementary branches of education. Under these circumstances, the Committee feel that as a *lace school merely* they cannot claim for this school the further support of Government; at the same time they must express their full conviction of its value and importance in other respects.

The progress of the pupils during the past year has been in every respect satisfactory, and most gratifying letters have been received from the parents of the children, testifying to their appreciation of their improvement, as well in disposition, manners, and healthful appearance as in their studies. It is with great pleasure that the Committee acknowledge their sense of the value of the Matron's (Miss Andrews) services, to whose unwearied care, zeal, and attention, they attribute the development and steady progress of the pupils.

The drawing class has continued to afford great satisfaction to the Committee, and the advantages it affords are better understood both by the pupils and their parents. In October last Mr. Bowler inspected all the drawings executed by the students, and expressed his approbation in high terms. Fifteen medals were then obtained by the students of the school of art, eleven of which were awarded to the lace-pupils for outlines from the flat, from the cast, from nature, and for designs for lace. The Committee desire to record their approbation of the energy and ability shown by the Art Teacher (Miss Ashworth), and to express their gratification at the rapid and very evident progress made by her pupils since their last Report.

The number of students attending the special class is fast increasing, since the success achieved by Miss Ashworth's pupils at the October examination has become more widely known.

An abstract statement of the year's accounts is subjoined.

(Signed) ELIZA BRUCE,
Honorary Secretary.

Abstract Statement of the Receipts and Expenditure of the Irish Normal Lace School for the year ending 31st December 1856.

Appendix C.

Normal Lace School, Dublin.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance in Bank 31st Dec. 1855	444	10	10	Salaries	197	14	6
Fees for students	31	10	0	Half-year's rent and taxes	32	18	9
Subscriptions	58	0	0	Furniture, including drawing desks	39	3	8
Maintenance of pupils	76	4	1	Coals, candles, soap, and gas	33	6	11½
Materials	5	3	7	Board of teachers, pupils, &c.	221	6	9¾
Day pupils	2	3	0	Materials, casts and models for school of art	25	0	3½
				Sundries, postage, books, carriage of casts, &c.	41	14	8½
				Washing and mangling	18	6	0¾
				Balance in Bank	7	19	9
	£617	11	6		£617	11	6

Report of Susan A. Ashworth, Teacher of Art to Normal Lace School, 76, Harcourt Street, Dublin.

Sir,

Being desired to continue the report I had the honour of making for the first time last year, regarding the progress of the Normal Lace School in art education, I do so with greater pleasure, feeling convinced that decided progress has been made in the right direction by the students under my instruction.

The number in the class appropriated exclusively to designers for lace has during the past year averaged from 17 to 20. Two who had made some slight proficiency in drawing were placed in country schools, and six were removed for causes stated in the report of the Committee. Eight of the pupils who commenced their art instruction on my arrival at this school distinguished themselves in the examination of the drawings, conducted by Mr. Bowler (the Art Inspector) in October last, and were awarded 11 local medals. I cannot refrain from expressing my gratification at the respectful attention paid to my instructions by all the students, and the eagerness shown by them to profit by every means calculated for their advancement in the knowledge of this branch of art. None of those obtaining medals have received instruction longer than one year and two months; many not so long.

Names of the Successful Competitors for Local Medals.

Ellen Bullen, Monitress	Outline from the flat Outline from the cast Outline of a plant from nature	3 medals.
Mary Godwin	Outline from the flat A design for a lace collar	2 medals.
Catharine Duggan	Outline from the flat	1 medal.
Catharine Luddon	Outline from the cast	1 medal.
Jane Phillips	Outline from nature of a plant	1 medal.
Eliza Ross	Design for a collar	1 medal.
Anna Lavin, English Lace Teacher	Design for a collar	1 medal.
Mary J. Bullock	Outline from the cast	1 medal.

Appendix C.

NORMAL LACE SCHOOL, DUBLIN.

It must be remembered that the students in this class have only two hours, five days in the week, to devote to the study of drawing and design. Five "honourable mentions" were also bestowed on this class by the Art Inspector, who expressed much satisfaction at the way in which the system of art instruction approved by the Department had been carried out.

The special class also did its part in the October examination, but, owing to the smaller number of pupils contained in it, fewer rewards were obtained.

The following is a list of the successful competitors :—

Mary Jane Nicholls -	Designs for lace - - Designs for printed muslins	2 medals.
Rebecca Nicholls -	Study in water-colour of flowers from nature -	1 medal.
Mina Otway - -	Study in outline of a plant from nature - -	1 medal.

This special class has been steadily increasing since the local exhibition of drawings in October, and it numbers now 30 pupils.

The total amount of medals received by this school last October was 15. Nine of the drawings receiving medals were sent to London to compete for the national medal.

Before closing this report, I must beg to express my thanks to the Committee of this school for the kindness and willingness with which they have acceded to any suggestions proposed by me for its benefit ; and if the number of students seems small, this will be found, on investigation, to proceed, not from any supineness in giving publicity to the school of art, but from the opposition encountered at the outset by every new undertaking in this city.

The rapid increase of my classes during the last quarter gives me every reason to expect that my next year's report will show a much larger attendance.

To the Secretary of the
Department of Science and Art.

Annual Report of the Director of the Industrial Museum of Scotland.

Laboratory of the Industrial Museum of Scotland,
Edinburgh, 31st January 1857.

Sir,

The progress which this Institution has made during last year will best appear by considering separately the Museum, the Laboratory, the Chair of Technology associated with them, and the incidental relation of all three to the interests of the public.

The Museum has been largely enriched, since the date of my last report, by donations and purchases. His Grace the Duke of Argyll has presented examples of the granites and building stones occurring on his estates. His Grace the Duke of Buccleuch has authorized the receipt by the Director of the minerals wrought in his lands; and already, through the active co-operation of those in immediate charge, viz., Mr. Alexander Gordon at Dalkeith, and Mr. Edward Gibsone at Canonbie, specimens of the coals, clays, limestones, and sandstones of the Dalkeith and Canonbie coalfields, along with the tools used in working them, have been received; and a series of the lead ores and products of the Wanlockhead mines and works is nearly completed.

The collection of building stones, commenced last year, has been increased by a gift from the Museum of Practical Geology, Jermyn Street, London, of their duplicate specimens, and by donations of single interesting examples from various individuals. Mr. William Lim, lessee of the furnace quarries near Inverary, has, with much kindness, superintended the preparation of a series of blocks of granite, illustrating the mode of working it in its various stages; and has had constructed under his own inspection the various tools employed in quarrying, dressing, and carving the stone. These implements are furnished at cost price. Messrs. Lawson and Son, of Edinburgh, are at present arranging the building stones of fifteen counties of Scotland, which will be transferred to the Museum in a few days. They have already consigned to it about fifty examples of the woods used in the industrial arts, which are grown in Great Britain. To this series James Johnstone, Esquire, M.P., of Alva, has contributed an entire section of the stem of an unusually large and fine cedar grown on his estate, and believed to be 160 years old.

In the metallurgical series considerable progress has been made in the collection of specimens illustrating the industrial applications of lead. In addition to the examples from Wanlockhead, Messrs. Hay and Addis, of Edinburgh, have contributed interesting specimens of the modes in which lead water-pipes suffer tear and wear. Mr. F. A. Abel, the chemist to the Ordnance, Woolwich, has supplied illustrations of the manufacture of common and Minie bullets; and Messrs. Lock and Blackett, Newcastle, have contributed a large number of examples of patent small shot, and of the stages in the production of white lead, massicot, and red lead.

Appendix C.

Industrial Museum, Scotland.

In the aluminium series a promising commencement has been made. Mr. Allan Dick has presented one of the pieces of metal first manufactured in England; Mr. A. Christie has presented a piece of French Manufacture; and an ingot has been obtained by purchase from Paris. A donation has been received from the Museum of Practical Geology of a large mass of cryolite, the chief ore of aluminium; and Messrs. Wilson, of the Harlet Works, near Glasgow, have sent a very fine group of crystals of ammonia-alum. A large number of other aluminious compounds have been collected, but for the present they are arranged under the ceramic, the dyeing, and other series.

In the iron series considerable progress has been made. Dr. D. R. Rankind, of Carluke, has contributed a number of the iron ores, coals, and associated important minerals of the Lanarkshire coal-field, and promises many more. William Murray, Esquire, of Monkland, has sent a valuable collection of ores, fuel, fluxes, slags, and manufactured metal from the Monkland Iron Company's works. Messrs. Lash, Wilson, and Bell, Newcastle, have made a most liberal gift of iron ores and samples of manufactured iron; and the Museum is under equal obligation to Messrs. Hird, Dawson, and Hardy, Lowmoor Iron Works, for a very interesting series of similar specimens. Professor Dick, of the Veterinary College, Edinburgh, has presented samples of his patent steel, made simultaneously with gas, in the ordinary coal-gas retorts. Messrs. Harrison Brothers, and Howson, of Sheffield, have sent a full series of illustrations of all the stages in the manufacture of steel knives and forks; and Messrs. Healey and Sons have sent similar illustrations of the stages in the manufacture of watch keys. Mr. Atkinson, of Sheffield, has made a similar contribution; and from Messrs. Turton and Sons, of the same town, large and very beautiful specimens have been received, showing all the steps through which iron passes before it becomes such edge tools as axes, planes, and augers. It will further appear from another portion of this report that additional illustrations of the steel manufacture will soon be received.

A beginning has been made in the nickel series by the gift, from Martin, Hall, and Co., Sheffield, of a set of examples of the stages through which an electro-plated German silver spoon and teapot pass from the nickel alloy to the finished article.

In fuel, a considerable collection of coals and a small one of peats have been effected. To the liberal donation, illustrative of the candle manufacture, made by Price's Candle Company last year several additions have been made; and a curious collection of black candles, made from the Binnie bitumen, have been presented by Mr. David Lind, lessee of Binnie Quarry. From the Dalkeith Gasworks, through the manager, Mr Young, very fine specimens of coal-gas graphite have been procured. From Bathgate, through Mr. Hasic, examples of the Boghead coal or Torbane-hill mineral have been obtained; and from the Bathgate Chemical Works, through Mr. James Young, specimens of the paraffine, paraffine-oil, and peculiar naphtha distilled from that mineral.

Dr. Ronalds has sent from the Bonnington Chemical Works, near

Edinburgh, twenty-eight specimens, illustrating the various useful products obtained from the tar and ammoniacal liquor of the Edinburgh Gasworks; and Mr. Greville Williams, of the University Chemical Laboratory, Glasgow, has presented specimens of four of the rarer volatile bases found in coal tar.

Messrs. Turnbull, of Glasgow, have furnished, free of all charge, wood charcoal, along with a series of large and very beautiful examples of all the useful products obtained by the destructive distillation of wood. Mr. Abel has supplied, from the Woolwich Laboratory, the woods and charcoals employed in making gunpowder, along with the sulphur and other ingredients of that explosive. Under this head also, in connection with lucifer matches, may be noticed the liberal gift, by Mr. Albright, of Oldbury Chemical Works, near Birmingham, of a number of exceedingly fine specimens, illustrating the manufacture of phosphorus in all its stages.

In glass, Mr. Ford, of Edinburgh, has furnished the raw materials used in the flint glass manufacture, and will immediately prepare a series of annealed examples of the forms through which glass vessels pass. He is also superintending the construction of a set of glassmakers' tools.

Messrs. Pellatt and Co. have made a gift of stoppered vases containing the materials employed for flint glass and the different coloured glasses. Messsrs. Hartley, of Sunderland, also have presented a very instructive series of examples exhibiting the manufacture of crown glass, flattened cylinder glass, and coloured lenses for signal lamps; and, through the kind co-operation of Mr. J. Russell, of Edinburgh, the St. Helen's Glass Company are preparing for the Museum illustrations of their glass manufacture, which are daily expected.

In pottery, a large collection of specimens has been made. Messrs. Wedgwood have contributed a number of the wares for which they are famous, peculiarly adapted by their size for illustrating demonstrations on the ceramic art. In addition, they have furnished, to order, a systematic series of large specimens, including raw materials, vessels in their different stages, moulds, and models of furnaces. The Museum is under great obligations to Mr. Godfrey Wedgwood for his assistance in suggesting the objects most desirable for our collections, and for the personal superintendence which he has given to the effective fulfilment of the wishes of the Director, as well as to the liberal spirit in which Messrs. F. Wedgwood and Brown have dealt with him in charging for the objects purchased.

To Mr. Christopher Maling, Potter, Newcastle, the Director is under similar obligations. Learning incidentally of the existence and objects of the Museum, he offered to become a contributor to it, and was at the trouble to visit the collections, with a view to arrange as to the specimens most desirable to be sent. A first and large instalment of these has been received, which Mr. Maling has recently visited Edinburgh to classify and catalogue.

By the Port Dundas Pottery Company, Glasgow, through the active co-operation of Mr. Millar, examples of their wares have

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been liberally presented, and this gentleman has cordially entered into the wishes of the Director in preparing illustrations of the manufacture of stoneware in all its stages.

From Messrs. Minton and Co. specimens of their china have been purchased on liberal terms; and a series of faithful working models of the Potter's machines and tools has been constructed for the Museum by Mr. Leveson Leak, of Hanley, Staffordshire.

Mr. Allardyce, of Aberdeen, has furnished, free of charge, specimens of his bricks, tiles, and drain pipes; and from Dalkeith and Canonbie, examples of these have also been obtained.

Several parties have also presented single examples of different kinds of ceramic ware, and before long considerable additions will be made to various departments of this extensive series.

Of the various manufactures from horn a very considerable number of illustrations has been acquired. Messrs. Blackhall and Scott, of Edinburgh, undertook, at the request of the Director, the preparation of examples, exhibiting the stages in the manufacture of combs, spoons, &c., from horns and hooves, including in the case of combs, tortoiseshell; and these, along with the tools employed, have been deposited in the Museum at an almost nominal cost, through the liberality of Mr. Scott.

This series has been supplemented by Mr. Robert Stephenson, comb maker, Edinburgh, who, in addition to articles in horn and tortoiseshell, has contributed as a free gift illustrations of the applications of ivory in the manufacture of combs; some purchases have also been made from him to extend the ivory series.

From Messrs. Fisher and Sons, of Sheffield, an extensive assortment of the horns used in commerce has been purchased, along with a series of carefully graduated specimens, illustrating the manufacture of knife handles, umbrella handles, &c.

In the hair series, Mr. Geikie, of Edinburgh, has furnished an assortment of examples of the uses to which human hair is put. In connection with the hair of the lower animals, Mr. Thomas Duncan, of Edinburgh, has deposited in the Museum a large number of specimens, illustrating in detail all the steps in the manufacture of brushes of the most varied kinds, including all the raw materials and special tools employed by the brushmaker. These illustrations have been acquired at cost price, and the Museum is under great obligations to Mr. Duncan for the cordial way in which he has co-operated with the Director in furnishing, at much personal trouble, all that could render intelligible his important craft.

Similar goodwill and liberality have been shewn by Mr. Oliver and Mr. Mein, Hatters, Edinburgh, in exemplifying the hat manufacture, which is referred to here, although their contributions refer more to silk hats than to those of felt or beaver.

In wool, Mr. Girdwood, of Edinburgh, has nearly completed a collection of fleeces of the different Scottish breeds of sheep, which he has announced his purpose of presenting to the Museum. From Messrs. P. and R. Sanderson, of Galashiels, and Mr. Wilson, of Earlston, examples of the several stages in the manufacture of tweeds and blankets, have been acquired, partly by gift, partly by purchase; but in both cases the Museum has been dealt with

on most liberal terms, and the parties in question have taken great trouble in assisting the Director to select specimens, and in arranging these so as to meet his wishes. To Mr. George Lees, of Galashiels, the Museum is under similar obligations for illustrations of the manufacture of the finer woollen shawls.

In the flax and jute series, a commencement has been made through the Chamber of Commerce, Dundee, and by the unofficial exertions of its Secretary, Mr. Robert Sturrock, as well as by the liberality of Mr. James Neish, jute carpet maker.

In cotton, including calico-printing, a commencement has been made through the good offices of Mr. Walter Crum, of Thornliebank, Glasgow, Mr. Alexander Harney, of Govenhaugh, Mr. Gordon Wilson, Campsie, and Mr. Grey, of the Print Works, Vale of Leven; but circumstances have prevented more than a beginning being made in this series.

Of the dyes used in calico-printing a gift has been made by Messrs. William Brown and Co., Glasgow. Messrs. Harpin and Co., of Liverpool, have been equally liberal with the various dye woods; and from St. Rollox Chemical Works, Glasgow, Messrs. Tennant have sent, free of cost, a complete series of the acids, alkalies, and special agents used in bleaching, besides the other chemical reagents manufactured on their extensive premises. To the personal exertions of Mr. Charles Dunlop, of Glasgow, and Mr. John Tennent, of Bonnington, the Director is greatly indebted for the care and pains with which the St. Rollox products have been collected.

In illustration of the manufacture of paper, Charles Cowan, Esq., M.P., for Edinburgh, has presented examples of the process of paper-making, as carried on at his spacious mills.

Mr. Thomas Hancock, of the firm of C. Macintosh and Co., has contributed an extensive assortment of manufactures in common and vulcanized india-rubber.

In the graphic arts a commencement has been made, through the donation by Messrs. Rowney, of London, of the commercial varieties of black lead, native and artificial, and of illustrations of the stages in the manufacture of pencils. To these may be added the stones and other materials used in lithography, contributed by Mr. G. E. Madeley, of London, and Messrs. Schenck and Macfarlane, of Edinburgh.

The collection of industrial objects thus acquired is considerable. But it will monthly undergo increase. With a view to interest the Scottish manufacturers in the Museum, the Director visited, at his own charge, bleaching works and carpet manufactories in Stirlingshire, several of the wool mills on the middle district of the Tweed and various of the large industrial works in Glasgow and its neighbourhood. Mr. Gallctly, the resident assistant in the Museum, who is most faithful and untiring in his labours, visited Tweedside, Wanlockhead, Dundee, and Aberdeen during last autumn. From these large towns as well as from the rural districts first instalments of contributions have already arrived, and others are definitely promised within a limited period.

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In conformity, also, with a resolution announced in last year's report, Dr. Sullivan, Chemist to the Museum of Irish Industry, made a tour in autumn through the chief northern and midland manufacturing towns of England, at the conjoint expense of the Scottish and Irish Museums, with a view to purchase illustrations of the economic arts for both collections. He was liberally dealt with by almost all to whom he applied. Many of the parties declined all remuneration for the samples of manufactures which they furnished, and have already added their gifts to this Museum. Circumstances, however, have prevented several from sending their contributions in time to be included in this year's report; but as in Newcastle, Sunderland, Birmingham, Sheffield, Bradford, and Leeds explicit arrangements have been voluntarily entered into by leading manufacturers, to send with the least avoidable delay, the objects which have been commissioned for the Industrial Museum, a large addition to its contents may be expected in the course of the spring.

An Industrial Museum cannot be complete, without historical illustrations of the progress of the useful arts. Accordingly, whilst seeking to avoid any intrusion on the domain of archæology, the Director has solicited contributions of examples exhibiting the early forms of important instruments, and has begun by presenting an antique working model of the first glass friction electrical machine. Messrs. Kemp, of Edinburgh, have responded to this solicitation, by sending several of the earliest galvanic batteries and other instruments constructed by the late Mr. Kenneth Kemp, along with four unique specimens of liquefied gases. Mr. Alexander Bryson, of Edinburgh, has contributed one of the calc-spar polarising prisms, which was made by their inventor the late William Nicol at the age of 80; and the Edinburgh County Prison Board have presented the coins, copper-plates, and other objects recently recovered from the foundation of a public building commenced fifty years ago. They are interesting examples of former modes of working in glass and metals, whilst they are too recent to be of value to the antiquary.

An Industrial Museum moreover, cannot be complete without illustrations of the existing state of the useful arts, among the less civilised nations of the world. A correspondence accordingly has been opened with agents in different quarters of the globe, which is likely to prove fruitful. A small collection of the objects manufactured by the Bassouta Africans has already been acquired. The simple forms of spinning machinery still in use in Madeira are on their way to this country. From Western Africa, Chili and the Red Indian districts (especially Minnesota) of the United States, intelligent men interested in the Museum have engaged to send examples of the native manufactures of those countries; and the Royal Society of Arts of Jamaica is collecting for the Museum the woods and other vegetable products and raw materials of the island.

From China, at the cost of Patrick Dudgeon, Esq., of Cargen, Dumfries, a magnificent gift to the Museum was shipped last

August, consisting of an extensive series of illustrations of the native cotton manufacture from the cotton seed pod to the finished cloth, along with spinning wheels, looms, printing blocks and patterns of chintzes. This consignment has latterly been anxiously looked for every day, but with the greatest regret the Director has to announce the receipt of a letter informing him that the ship bearing this gift and chartered for London, is long past due, and as there is too much reason to fear has been lost at sea. The loss to the Museum will be the greater, that the present state of China forbids the hope of readily replacing the objects which have probably perished; and as they were not insured, the intending donor will have less than no return for his generous purpose towards the Industrial collections. Mr. Dudgeon, nevertheless, is still willing to look after the interests of the Museum in China.*

Various models of the machines employed in the Industrial Arts have been commissioned and are in progress, but their construction is a work of time, and reference to them is reserved till they are completed.

II. The laboratory of the Museum has been in active operation during last year; two private assistants in addition to Mr. Bloxam, the official chemical assistant, who has laboured most efficiently, having taken part in its duties, under the Director. More than a hundred analyses have been made of natural substances, raw and manufactured articles, and objects connected with the industrial arts. Among the substances examined have been twenty waters; twenty guanos and other manures; eight building stones; eleven ores, clays, and other minerals; four metallic alloys; five animal products, including milk, butter, and oil; nine vegetable products, including tea, bread, tobacco, wine, beer, brandy, and straw paper; and various miscellaneous objects such as pottery, white lead, sulphur, old mortar, and printer's ink.

The Director in addition has, at the request of parties concerned, made investigations in connection with two industrial inventions involving the rights of patentees, on which he has reported at length; and by desire of two of the public banks, he has made a detailed inquiry into the means of preventing photographic and other forgeries of bank notes, and has submitted a report which is about to be acted on.

The pupils in the laboratory have numbered twenty-four. They have engaged in the prosecution of chemical analysis, for periods varying from one month to six, during which from two to five hours have, on an average, been spent daily in conducting analytical investigations.

III. The students of the University Class of Technology number fifty-two. Six attended the lectures last year; the others attend

* Whilst this is passing through the press, I have received a letter from London, informing me that the Agra has reached that port in safety, and that the cases containing Mr. Dudgeon's donation to the Industrial Museum are on their way to Leith.—G. W., Feb. 18, 1857.

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for the first time. As the subjects chosen for prelection differ from those of the preceding session, the course, with the exception of some generalities and detail of first principles, which must be repeated every year, is new to all. The class (which is not imperative on any University student) is to a great extent composed of seniors of the legal, military, and medical professions, besides amateurs unconnected specially with any calling; the juniors are young men, under training as engineers, dyers, paper makers, silk weavers, merchants, farmers, teachers, and lawyers; or are preparing to emigrate to the colonies. By a body of men, intelligent and educated to the extent the students of technology are, and heartily interested as each is in the progress of the Industrial Museum, its claims are commended to a greatly wider circle of influential persons; and directly and indirectly the Museum is already, in no small degree, indebted to the technological pupils for contributions to its collections.

In addition to attending the daily lectures, the students have visited, when opportunity offered, such places as iron foundries and glass houses, with the Professor or his assistants, and those visits have had the important secondary result of interesting the workmen in those establishments in the Museum. In illustration of this it may be mentioned, that the workers in a large glass house, recently took advantage of a holiday to come in a body with a request for a lecture on the history of glass making, which was at once complied with; but till an industrial lecture-room is erected it will be very difficult for the Director, however willing, to meet such requests.

IV. The contents of the Industrial Museum cannot, till the new buildings are erected, be made available to the general public. The Director, in consequence, has taken advantage of every opportunity which presented itself to commend the Museum to the more educated portion of the non-academic classes of the community, through the medium of lectures. In January 1856, accordingly, he gave an address at one of the monthly meetings of the Highland and Agricultural Society, "On the Relations of Technology to Agriculture," which was published in the "Society's Transactions," for March 1856. In February two lectures were delivered to the Philosophical Institution of Edinburgh "On the Objects of Technology and Industrial Museums," which were afterwards published, by request, in a local newspaper having a wide circulation among the working classes, and thereafter reprinted. In March, by request of the Pharmaceutical Society, an address was delivered to them "On Pharmacy as a branch of Technology," which has since been published in the "Pharmaceutical Journal," for April 1856. The Society has engaged, in acknowledgment of its interest in the Museum, to charge itself with procuring for the collection of chemical re-agents, choice specimens of such pharmaceutical substances as are of industrial interest.

In December, by request of the Educational Institute of Scotland, an address was delivered at one of their monthly meetings, "On Technology as a Branch of Education;" and a strong expression of interest in the Museum was formally approved by the influential body of teachers present.

On Christmas Eve, by request of the committee of the "Art-Manufacture Association," a lecture was delivered "On the Relation of Industrial to Ornamental Art," which the committee has since published. In return for the service thus rendered, the Art-Manufacture Association gave the students of the technology class free access to the rarest specimens of works of Art in their important collection, and at the close of their exhibition, the Director was allowed to purchase objects for the Industrial Museum on very favourable terms.

It has been impossible in the preceding statement, extended though it is, to name all the donors to the Museum, or to indicate all the proofs which could be given of a wide public interest in its progress. The Director, however, cannot avoid calling attention to the strong feeling of disapprobation with which the community have received the rumour (which for them was authentic), that Government would not fulfil its promise to proceed as speedily as possible with the new Museum buildings. Deputations from various public bodies have waited upon him, seeking information which it was not in his power to give. He has not hesitated, however, to state in reply to their questions, that the careful endeavour which was made by himself and his colleague, Professor Allman, last summer, to ascertain, in conformity with your request, the capabilities of the purchased site for a Museum, which should properly represent Natural History and Industrial Science, satisfied both parties that the area in question is quite inadequate for the twofold purpose. An increased conviction of this inadequacy now induces him to urge upon you the importance of securing, if that be possible, additional space, before architects are applied to for plans.

The accumulation of Industrial, even more than of Natural History specimens, must be a slow process, as the Director daily realises, and he does not desire the *rapid* erection of extensive galleries; but the question, how spacious shall these be, how they shall be lighted, how many accessory lecture theatres, laboratories, libraries, storerooms, and other essential apartments shall be provided, and in what portions of the building they shall be placed, must be considered from the first.

The certainty on the one hand, that the galleries for which the purchased site affords room will be filled in a few years; the certainty, on the other hand, from the experience of all existing Museums, that gallaries, much more extensive than these can be, are requisite for the proper fulfilment of the ends which the Museums are intended to serve; and the known facilities which at present exist for acquiring additional space in the neighbourhood of the purchased site, induce the Director to be thus urgent. He

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trusts that he may plead in excuse of such urgency, the absence of any personal motive in making this appeal. An increase of the Museum will but add to duties and responsibilities already sufficiently onerous.

GEORGE WILSON,
Director of the Industrial Museum.

To the Secretary of the
Department of Science and Art.

Annual Report of the Regius Keeper of the Museum of Natural History, Edinburgh.

In presenting a Report of the progress and present state of the Museum of Natural History for the year ending 31st December 1856, I have much pleasure in being again able to refer to the satisfactory working of the new regulations, by which the Museum has been thrown open to the public, on one day in each week, free of charge.

Monthly Returns have been regularly forwarded for the information of Government, and it will be seen by these, that the Museum continues to be visited by very large numbers. It is evident, indeed, that the interest taken in it by the public remains unabated, any diminution in the number of visitors being only such as must almost necessarily have occurred when the novelty of the first working of the new system had passed by.

The following is a General Return of the number of Visitors from the 1st January 1856, to the 31st December 1856, inclusive :—

Number of Visitors on free days (Saturdays and public holidays) - - - - - - -	87,360
Number of Visitors on close days, at a charge of 6*d.*	3,410
Total -	90,770

The money received on close days, as charge for admittance, amounted, for the entire year, to £85 5*s.* 0*d.*

On an application from the Town Council, it was agreed to extend the period during which the Museum had been kept open on free days, by changing the hours of closing on those days, during the summer months, from 4 o'clock to 5. This was done with the view of affording to the working classes an opportunity of visiting the Museum after the termination of their daily occupations, which in Edinburgh are mostly finished at an early hour in the afternoon of Saturday.

It is worth remarking, however, that this change was not taken advantage of to the extent that might have been expected, as may be seen from the following table, which gives the average attendance from hour to hour on open days :—

Hours of the Day.	Average Number of Admissions.
From 10 to 11 - - -	147
„ 11 to 12 - - -	363
„ 12 to 1 - - -	513
„ 1 to 2 - - -	594
„ 2 to 3 - - -	557
„ 3 to 4 - - -	387·5
„ 4 to 5 - - -	77·5
	2,639

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NATURAL HISTORY MUSEUM, EDINBURGH.

The Board of Trade having sanctioned the throwing open of the Museum to *bonâ fide* students of Natural History, a considerable number of such students have been admitted on close days without the usual charge.

During the present year, the Government has extended to students of the Natural History Class, of the United Presbyterian College, the special privilege of free admission on all days of the week, and to the general students of that College the privilege of free admission on one close day in each month. A similar privilege had already been granted to the students of the Free Church College, so that these two Colleges now possess for their students the same facility of access to the Museum, which had previously been confined to the students of the University.

Notwithstanding the large concourse of visitors to the Museum, I have the pleasure of again testifying to the uniformly good conduct which has prevailed even during the most crowded days. Though the rooms have been frequently filled with visitors to such an extent as to cause much inconvenience, and some apprehension for the safety of the collection, yet no injury of any consequence has been suffered.

During the present year many important purchases have been made, and some valuable donations have been received. The principal purchases consist in additions to the collection intended to illustrate the British Fauna, and in Fossils procured for the purpose of supplying as far as possible the more important deficiencies in the Paleontological Department of the Museum. Among the donations, almost all from old students of the University, are many valuable additions both to the Zoological and Paleontological collections.

By the will of the late Professor Edward Forbes, the whole of his valuable collection of Natural History was bequeathed to the Museum. Until the completion, however, of certain legal formalities, possession could not be taken of it, but the necessary preliminaries have been just finished, and the executors have now handed over the whole collection to the Museum.

The collection of Typical Forms has been far advanced towards completion.

Numerous additions have been made to the collection of British Animals, and in some departments this collection is already complete. Several new cases have been constructed for its display; these have been already filled with British species of Mammalia, Birds, Reptiles, Amphibia, and Fishes. The deficiencies in the British collection continue to be supplied, but the want of sufficient space for their arrangement and display is seriously felt.

The revision of the nomenclature, and the attachment of labels continues; while in the Typical collection, microscopic objects, or such as are too small to be easily examined in the cases, are accompanied by an enlarged drawing.

A collection of Fossils arranged in chronological order, and intended to illustrate the Paleontological characters of the various geological periods, has been commenced, and is already far advanced.

During the summer, many specimens of Invertebrate Animals were procured on the Scottish coast by means of the dredge, and a department in which the Museum had been previously very deficient has been thus considerably enriched.

I would, in conclusion, again beg leave to call attention to the fact, that every available spot of room has been appropriated, even to the overcrowding of the collection; that it is quite impossible within the present contracted limits, to display the specimens with advantage, that many of them are still incapable of being exhibited at all, and that the Museum is far less effective, as a means of public instruction, than it would be if greater space were at my disposal.

GEO. J. ALLMAN, Regius Keeper.

TRINITY HOUSE NAVIGATION SCHOOL, HULL.

MIDSUMMER EXAMINATION, 1856. PAPER No. 1.

Arithmetic.

The boys of the senior division are to answer the more difficult questions only in this paper.

1. Express in words 81000234610, and from eighteen millions two hundred thousand one hundred subtract nine millions twenty thousand and ten.

2. Multiply 824955316 by 3009. Divide 824975317 by 749; and take 127 guineas from 200*l.*

3. How many miles are there in one million inches, and how many acres in $1239493\frac{3}{4}$ square yards?

4. Multiply 1*l.* 13*s.* 8*d.* by 130, and divide 138*l.* 15*s.* 0*d.* by 150.

5. How much linen may be bought for 69*l.* 7*s.* 6*d.* if 243 yards cost 41*l.* 12*s.* 6*d.*

6. If the rent of 12A. 2R. 30P. be 28*l.* 8*s.* 9*d.*, what is the rent of 59A. 3R. 20P. of the same land?

7. A servant's wages are 18*l.* a year, how much is due for seven weeks and three days?

8. If the expenses of a family of 8 persons amount to 42*l.* in 16 weeks, how long will 100*l.* support a family of 6 persons at the same rate?

9. Reduce $\frac{4}{7}$ of a guinea to a fraction of 10*l.*

10. How many times can $\frac{3}{4}$ be taken from $15\frac{3}{4}$?

11. If five-ninths of a ship be worth 1,300*l.*, what the value of seven-tenths of it?

12. If 84 gallons of rum cost 50*l.*, how many gallons of water must be added to reduce the value to 11*s.* $4\frac{1}{2}$*d.* per gallon?

13. If a pasture serves 101 horses $18\frac{2}{3}$ days, how long will it serve 48 horses?

14. From $\frac{2}{3}$ of $\frac{7}{8}$ take $\frac{1}{2}$ of $\frac{5}{6}$.

15. Find the continued product of $4\frac{1}{3}$, $5\frac{1}{3}$, and $6\frac{3}{4}$.

16. Divide ·00123648 by ·012.

17. Reduce $\frac{7}{180}$ to a decimal.

18. Reduce $\frac{7}{365}$ to a decimal.

19. $89° \cdot 47' \cdot 56'' \times 9$.

20. How many cubic feet of timber are there in 23 rafters, each 15 feet long, $4\frac{1}{2}$ inches deep, and $2\frac{1}{2}$ inches wide?

21. At what rate per lb. must I buy sugar which I sell at 7*d.* per lb., in order to gain 18 per cent.?

22. The standard coin of this realm is made up of 37 parts pure silver and 3 of copper, and a lb. troy of this compound metal yields 66 shillings; what weight of pure silver is there in 20*s.*?

Appendix C.

TRINITY HOUSE NAVIGATION SCHOOL, HULL.

Algebra.

Solve the Equations,—

1. $\frac{9}{2x} - 4 = \frac{2}{3}$.

2. $x - \frac{3x-2}{5} = 3 - \frac{2x-5}{3}$.

3. $\frac{x}{x+1} - \frac{x+2}{3x} = -2$.

4. $x + \frac{3x-5}{2} = 12 - \frac{2x-4}{3}$.

5. $\frac{2x-3}{3} - \frac{10x-4}{18} = -1$.

6. $\left.\begin{aligned} \frac{7+x}{5} - \frac{2x-y}{4} &= 3y - 5 \\ \frac{5y-7}{2} + \frac{4x-3}{6} &= 18 - 5x \end{aligned}\right\}$.

7. A is twice as old as B; twenty-two years ago he was three times as old. Required A's present age.

8. I take a number, multiply it by $3\frac{3}{7}$, take 60 from the product, multiply the remainder by $2\frac{1}{2}$, and after this subtract 30, when nothing remains. What is the number?

9. Three boys, A, B, C, have 96 marbles among them; they then play together, and B and C each double their marbles by their winnings of A; next, A and C do the same by their winnings of B; and lastly, A and B do the same by their winnings of C. The marbles are found then to be equally divided among them. How many had each at first?

Euclid.

1. If the angles at the base of a triangle be equal to each other, the sides also which subtend or are opposite to the equal angles shall be equal.

2. The exterior angle of a triangle is greater than either of the interior and opposite.

3. If two triangles have two sides of the one equal to two sides of the other, but the angle contained by the two sides of the one greater than the angle contained by the two sides equal to them of the other, the base of that which has the greater angle shall be greater than the base of the other.

4. Parallelograms upon the same base and between the same parallels are equal to one another.

5. In a right-angled triangle, the square of the side subtending the right angle is equal to the sum of the squares of the sides containing it.

6. If a straight line be divided into any two parts, the square of the whole line is equal to the squares of the two parts, together with twice the rectangle contained by the parts.

7. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square of the line between the points of section, is equal to the square of half the whole line.

8. To find the centre of a given circle.

9. If a straight line, drawn through the centre of a circle, bisect a straight line in which it does not pass through the centre, it shall cut it at right angles; and if it cut it at right angles, it shall bisect it.

10. To draw a tangent to a given circle, from a given point, either without or in the circumference of the circle.

11. The angle at the centre of a circle is double of the angle at the circumference upon the same arc, that is, upon the same part of the circumference.

Trigonometry.

Prove the following formulæ:—

1. $\text{Tan } A = \dfrac{\text{Sin } A}{\text{Cos } A}$
2. $\text{Sin } A = 2 \text{ Sin } \frac{1}{2} A \text{ Cos } \frac{1}{2} A$
3. $\text{Cosec } A = \dfrac{1}{\text{Sin } A}$
4. $\text{Cot } A = \dfrac{\text{Cos } A}{\text{Sin } A}$
5. $\text{Sin } (A + B) = \text{Sin } A \text{ Cos } B + \text{Sin } B \text{ Cos } A$
6. $\text{Tan } 2A = \dfrac{2 \text{ tan } A}{1 - \text{tan}^2 A}$
7. $\text{Sin } (A - B) = \text{Sin } A \text{ Cos } B - \text{Sin } B \text{ Cos } A$
8. In any plane triangle
$$\text{Sin } \tfrac{1}{2} A = \sqrt{\frac{(S - b)\ (S - c)}{b\ c}}$$
9. In any spherical triangle
$$\text{Cos } a = \text{Cos } b \text{ Cos } c + \text{Cos A Sin } b \text{ Sin } c$$

The sides a and b of a plane triangle are respectively 627 and 1140, and the included angle C is 34° 39′ 26″; find the two other angles.

The summit A of a hill bore due east of a spectator at B, and E.N.E. of a spectator at a point C due south of B; the elevation of the point A at B was 20°; required its elevation at C.

Magnetism.

1. Given a piece of loadstone or natural magnet, and a piece of unmagnetized steel, how may the latter be converted into a magnet?

When suspended from its centre of gravity in London, state the exact direction in which the magnetic axis of the steel will set.

2. A rod of steel, before magnetization, is exactly balanced upon a point placed beneath its centre of gravity, will the balance be effected by the magnetization of the bar: if so, in what way?

3. When a north pole acts upon a north pole, or a south pole upon a south pole, what is the effect? State the mutual action of a north pole and a south pole upon each other.

4. What is the meaning of magnetic induction? Name the most prominent magnetic substances: if two north poles of the same power act together upon a sphere of soft iron, what occurs? if a north pole and a south pole of equal powers act simultaneously upon a sphere of soft iron, what occurs?

5. The north or marked end of a magnetic needle is drawn towards the north magnetic pole of the earth; why, then, when the needle is permitted to float upon a liquid, is there no motion of the needle towards the pole referred to? Is the weight of a steel needle affected by magnetizing it?

Appendix C.

Trinity House Navigation School, Hull.

6. Explain the terms "variation," "deviation," and "dip."

7. A ship sails before the wind S.W., upon a level keel, and her compasses show a certain amount of variation, she then tacks and sails upon a North-west course, and is "heeled over" 10°; is the amount of variation in both courses constant?

8. Write out what you know about the relation between the dip of the needle, and the latitude of the place.

9. Where, upon the earth's surface, would I find that the needle had no dip?

10. A ship leaves the port of Hull for Table Bay, will the compasses throughout the voyage indicate the same amount of variation?

11. Explain the methods of "swinging the ship."

The Atmosphere, Heat, and the Steam Engine.

1. What are the constituent parts of atmospheric air, and what are their chemical properties? How may it be analyzed?

2. If two straight bars of copper and iron, both at a freezing temperature, be united rigidly together, side to side, and immersed in boiling water, will the compound bar remain straight? If not, which bar will lie towards the concave circumference, and why?

3. On what principle does an ordinary fire balloon ascend in the atmosphere? Does the force of ascent diminish as the balloon rises? At what point does this force become zero, and the balloon cease to ascend?

4. Describe as far as you know, the changes which take place in coal during its combustion in the grate: state the products of this combustion, and their influence upon animal and vegetable life.

5. Are the hottest flames always the most luminous? If not, state an example to the contrary. Describe fully the circumstances on which the light of an ordinary gas flame depends?

6. Describe the safety-lamp of Davy; and state the scientific principles on which the construction of the lamp is based.

7. Describe minutely the "heating," "feeding," "driving," and "working" parts of a condensing steam engine.

8. Sketch the interior of a locomotive engine, and show how it acts.

9. What is meant by the pitch and slip of the screw propeller.

Examination Paper No. 2.

Navigation and Nautical Astronomy.

1. Sailed from Shetland in latitude 60° 9′ N., longitude 0′ 56″ W., upon the following true courses:—N.E. by N. 180 miles, N.N.W. 240 miles, S. by W. ½ W. 110 miles, N.E. 284 miles, S. 96 miles. Find the longitude and latitude of place arrived at, and course and distance made good.

2. Find the course and distance from the Lizard, in latitude 49° 57′ N., longitude 5° 15′ W., and St. Mary's, latitude 36° 57′ N., longitude 25° 9′ W.

3. Required the compass course and distance from A to B.

Lat. A...64° 40′ S.	* Var. 2 pts. E.	Long. A...49° 10′ E.
B...69 20 S.		B...44 20 E.

4. Required the compass course and distance from A to B.

Lat. A...24° 15′ N.	* Var. 1 pt. E.	Long. A...15° 15′ W.
B...24 15 N.		B...17 30 W.

---

* See Table of Deviations.

5. Aug. 7th, 1856, at noon, a point of land, in lat. 26° 40′ N., and long. 72° W., bore by compass S.W. by W., distant 19 miles (ship's head being N.N.W.),* afterwards sailed as by the following log account. Find the latitude and longitude in on August 8, at noon.

H.	K.	$\frac{1}{10}$ths	Course.	Wind.	Leeway.	Remarks.
1	4	3	N.E. by N.	S.E.	1½	
2	3	4				
3	2	6				
4	3	8				
5	2	4				
6	4	0				
7	3	5				Variation of Compass 2¼ E
8	3	6				
9	2	4	N.W.byW.	N.N.E.	2¼	
10	4	3				
11	2	6				
12	3	–				
1	3	5				
2	4	6				
3	3	5				
4	2	6				A current set the ship the last four hours 3½ miles an hour S.S.W. by compass.
5	3	4				
6	2	–				
7	3	4	E.S.E.	S. by W.		
8	2	6				
9	4	4				
10	3	5				
11	2	6				
12	4	–				

6. May 3rd, 1856, in long. 19° 30′ 45″ W., the obs. mer. alt. of the sun's U.L. was 50° 36′ 10″ (Z.N.), index error + 4′ 15″, height of eye 20 feet. Required the latitude.

7. Sept. 16th, 1856, in long. 15° 30′ E., the observed meridian altitude of the moon's L.L. was 54° 20′ 30″ (zenith S. of the moon), the index cor. was — 5′ 20″, and the height of the eye above the sea was 20 feet. Required the latitude.

8. Oct. 30th, 1856, the obs. mer. alt. of Antares was 48° 20′ 30″ (zenith N. of the star), the index cor. was — 4′ 10″, and the height of the eye above the sea was 16 feet. Required the latitude.

9. January 8th, 1856, at about $2^h\ 19^m$ P.M., in lat. 56° 18′ S., long. 109° 14′ W., the obs. alt. of the sun's L.L. was 48° 0′ 54″, index error — 50″, height of the eye 11 feet, and the sun's bearing by compass was N. 35° 46′ W. Required the variation.

10. March 9th, 1856, in lat. 38° 20′ N., long. 35° W. at about $6^h\ 24^m$ A.M. mean time at place, the observed rising amplitude of the sun was E. 21° 37′ S. Required the variation.

11. May 10th, 1856, at $3^h\ 30^m$ P.M. (mean time nearly), in lat. 48° 30′ N., and long. 51° 20′ E., when a chronometer showed $0^h\ 20^m\ 40^s$, the obs. alt. of the sun's L.L. was 37° 22′ 10″, the index cor. was + 3′ 10″, and the height of the eye above the sea 18 feet. Required the longitude.

On April 19th, at noon, the chron. was fast on G.M.T., $20^m\ 10{\cdot}8^s$, and its daily rate was 3·5 sec. losing.

12. January 6th, 1856, in lat. by account 28° 6′ N., long. 48° 10′ 30″ E., the following alts. were taken near the meridian to find the latitude.

Chron. times. $9^h\ 14^m\ 20^s$
$15\ \ 0$
$15\ 45$
$16\ 10$
$16\ 58$

Mean of Obs. alts. ⊙'s L.L. 39° 19′ 15″

index error — 3′ 8″, height of the eye 17 feet.

* See Table of Deviations.

Appendix C.

TRINITY HOUSE NAVIGATION SCHOOL, HULL.

On December 23rd, 1855, the chronometer was slow on mean time at place $3^h\ 3^m\ 49^s$, losing daily $2{\cdot}5^s$.

13. April 30th, 1856, in lat. by account 25° 30′ S., long. by account 158° 40′ E., the following observations were taken to determine the latitude and longitude by Sumner's method :—

M.T. nearly.	Chron. times.	Obs. alt. ⊙
$9^h\ 15^m$ A.M.	$11^h\ 53^m\ 05^s$	33° 39′ 50″
3 38 P.M.	6 16 28	23 09 26

index error — 2′ 24″, height of the eye 19 feet,

On April 6th, at noon, the chronometer was fast on G.M.T. $1^h\ 14^m\ 36^s$, losing daily $4{\cdot}5^s$.

N.B. Latitudes used in the computation 25° S. and 26° S.

14. May 29th, 1856, in lat. by account 39° 50′ N., long. by account 109° 57′ W., the following observations were taken to determine the latitude and longitude.

M.T. nearly.	Chron. times.	Obs. alt. ⊙'s U.L.
$8^h\ 55^m$ A.M.	$4^h\ 5^m\ 16^s$	47° 51′ 50″
3 02 P.M.	10 12 37	47 15 35

index error — 2′ 23″, height of the eye 15 feet.

On May 10th, at noon, the chronometer was slow on G.M.T. $9^m\ 48^s$, gaining daily $1{\cdot}4^s$.

15. March 13th, 1856, in long. 61° 35′ E., at $9^h\ 36^m\ 39^s$ P.M., mean time at place, the obs. double alt. of Polaris was 99° 37′ 21″, index error + 1′ 25″. Required the latitude.

16. May 15th, 1856, in lat. 20° 33′ S., long. 95° E., when a chronometer showed $9^h\ 20^m\ 40^s$ A.M. and $2^h\ 40^m\ 30^s$ P.M. the sun had equal altitudes. Required the error of chronometer for apparent noon at the place.

17. April 9th, 1855, at $4^h\ 10^m$ P.M., in lat. 35° 20′ N., and long. by account, 10° 40′ E., the following lunar was taken.

Obs. alt. sun's L.L.	Obs. alt. moon's L.L.	Obs. dist. N.L.
25° 50′ 20″	34° 30′ 20″	58° 56′ 20″
Index error — 4 10	+ 1 20	+ 2 10

The height of the eye above the sea was 20 feet. Required the longitude.

Astronomy.

1. How is it known that the earth's surface is not a plane, as it seems to be, and how is it known that its shape is nearly that of a sphere, and that it turns round?

2. What is the cause of the tides—of some tides being higher than others, and of the times of high water being different on successive days?

3. Why do not eclipses occur every month? Why do similar eclipses return every nineteen years? How often would they return if there were no regression of the moon's nodes?

4. How is it known that we are at different distances from the sun at different times of the year? What law has been observed with regard to these distances, and by whom (first)? What important conclusion has since been drawn from it?

5. How has it been found out that the earth's orbit is an ellipse?

6. How has the distance of the sun been determined?

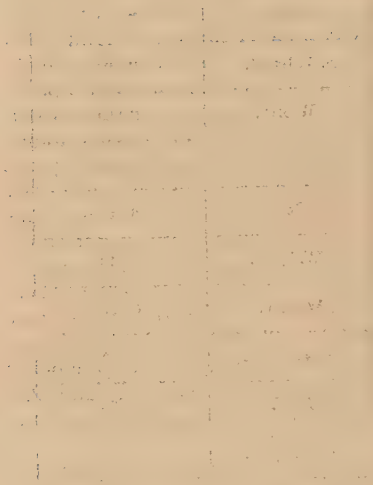
7. What is meant by a mean solar day? Explain the causes of the correction called "Equation of Time."

8. What distance are the inhabitants of Hull carried in twenty-four hours by the rotation of the earth?

9. Describe and explain the sextant, and show how its error may be determined.

Deviation of the Compass (caused by the local attraction of the Ship), for giving positions of the Ship's Head.

Direction of Ship's Head.	Deviation of Compass.	Direction of Ship's Head.	Deviation of Compass.
N.	2° 45′ E.	S.	3 0 W.
N. by E.	4 57	S. by W.	4 20
N.N.E.	7 30	S.S.W.	5 0
N.E. by N.	9 0	S.W. by S.	6 7
N.E.	10 0	S.W.	7 0
N.E. by E.	10 55	S.W. by W.	7 27
E.N.E.	10 40	W.S.W.	7 50
E. by N.	9 55	W. by S.	8 20
E.	8 50	W.	8 50
E. by S.	7 15	W. by N.	8 10
E.S.E.	5 35	W.N.W.	6 50
S.E. by E.	3 40	N.W. by W.	5 40
S.E.	1 50	N.W.	4 50
S.E. by S.	0 20 E.	N.W. by N.	3 20
S.S.E.	0 56 W.	N.N.W.	1 40 W.
S. by E.	2 20	N. by W.	1 10 E.



APPENDIX D.

Report on Local Schools of Art, on Examinations for Art-Certificates, and on Examinations in Drawing (First and Second Grades).

Sir, South Kensington, January 1857.

Local schools.

The reasons expressed in the report of the Art Superintendent (page 54) having determined the Department to change the manner of awarding the bronze medals, which were formerly given on a review of works forwarded to London; to institute examinations in some of the stages of instruction; and to establish a national competition for medals of a higher class: I have, in accordance with the instructions I have received, visited twenty-two Schools of Art. The rules (*see* page 24) show fully the nature of the examinations, the conditions on which the awards have been made, and the prizes obtained by successful candidates. The table at page 201 gives the name of each school, with the results obtained, showing a total of 367 medals and 1,269 prizes awarded; and that 222 works have been collected for the national competition. This table is not a just ground for making a comparison between different schools, or between this and former years, because some schools were necessarily visited sooner after the Autumn Exhibition of 1855 than others, and thus had a less time to prepare works; and because the experimental character of the examinations of this year has prevented uniformity of action.

As it is intended that each school should be revisited a year after the past inspection, the interval will, in future, be the same for all, and to insure such uniformity of action and reporting as will make the results a fair test of the working of the schools, I would suggest that revised copies of papers Nos. 127 and 232 should be sent to every master, and that a notice be printed and hung up in every school.

In nearly all towns the arrangement for annual inspection and examination has met with the cordial co-operation of the committee and masters, while a marked impulse has been given to the extension of elementary art-teaching.

Though I am unable to compare the schools with each other absolutely, the experience of the year has shown that there are many differences in their working; that while, in some, admirable results have been obtained by the combined exertions of energetic teachers, a good committee, and good opportunities, in some, the absence of one or other of these has retarded the progress of the work. In one or two, the master has shown a want of skill and tact; in one or two the committee has acted injudiciously In some, a close connexion between the teaching of the schools and the business of the district attracts public encouragement; in others, where this connexion is less obvious, the public is less interested.

Appendix D.

Report on Local Schools, &c.

One irregularity, too frequently observed, has it origin with the students, I mean the departure from sound principles of teaching, especially in the morning, or higher paying classes. The masters generally admit the defect, but plead the urgent wishes of the students for landscape lithographs or copies three times removed from Reynolds or an old master; and thus while every teacher has before him the declaration of Mr. Redgrave (in his Address of November 1852), "that what is good for the peer is good for the peasant also, in kind at least if not in degree; what is proper for the artizan is proper also for his employer; and that no training less than that which tends to a perfect education of the eye to see, and a perfect subjection of the hand to execute what the eye perceives, can be right in us to adopt, or students to seek to obtain;" we find that the mode of teaching he immediately afterwards so decidedly condemns, is in operation in some of the schools of the Department. I believe that this defect is an obstacle to the progress of that art knowledge which the Department is established to disseminate; that the Department must suffer by it in public estimation; and that aided as these schools are by the stimulus of Government prizes and prestige, it places them in unfair competition with private teachers of drawing; but some of these students are so resolutely bent on learning in their own way, that a strict adherence to sound teaching would, I fear, reduce the numbers of these classes, and thus interfere, at first, with the pecuniary success of the schools. Still, it is imperative that steps should be taken to remedy the evil, especially as in some of the smaller schools the morning classes claim the largest share of the master's skill and attention. It should be understood that the objection now urged is not to the subjects taught in these classes, where landscape-drawing or figure-painting may be legitimately studied, but to the departure from a principle of the Department, that a competent knowledge of the laws of form, colour, and light and shade should precede the application of the student's labour to any special branch of art. I would suggest that the masters be required to confine themselves to the course of instruction laid down by the Department; and that to counterbalance the loss they may sustain at first, the principle, (already in action with reference to pupil-teachers and public schools,) of attaching to the success of the pupil a bonus to the teacher, may be extended to the work in the central schools. I say the loss *at first*, for I feel confident that the decrease in the classes would be but temporary, and that eventually the appreciation of the soundness, usefulness, and pleasantness of the knowledge acquired, would at least raise them to their present numbers, and perhaps much higher, the more readily if the teachers, in carrying out the principles of the Department, perceive that it has for its object the spread, not only of the knowledge, but, of the love of art.

Examination of masters in training for certificates of the third grade.

At the end of each of the two sessions of the year 1856 in the Normal School, that is in February and July, the usual examination of masters in training for certificates took place. The nature of these examinations, and the method of conducting them are

explained by the papers, which will be found at page 189. The results are shown in the following Table and in the list, page 199.

	February.		July.		Total, 1856.	
	Number of Candidates.	Number who passed.	Number of Candidates.	Number who passed.	Number of Candidates.	Number who passed.
Group 1 - -	22	11	43	13	65	24
Group 2 - -	6	5	18	2	24	7
Group 3 - -	1	1	2	—	3	1
Group 4 - -	3	3	2	—	5	3
Group 5 - -	2	1	—	—	2	1
Group 6 - -	6	4	5	3	11	7
Total - -	40	25	70	18	110	43

In 1855, 92 candidates were examined, of whom 61 obtained certificates, or 66 per cent., while this year the proportion is 39 per cent. only. This apparent decline is occasioned by the admission of students to be examined in one or two only of the subjects required for the first or second group, with the intention of working the remaining papers at future examinations. In Group 6, all were candidates for the advanced mechanical certificate, except M. Protat, who obtained a high-class certificate for modelling.

Examination of Exercises in drawing by schoolmasters, schoolmistresses, and students in training schools.

The results, for the year 1856, of the Christmas examinations in drawing at the different training schools for schoolmasters and schoolmistresses is shown in Table, page 202, by which it appears that 1,646 persons have been examined, and 416 prizes and 33 certificates awarded.

These results are somewhat less satisfactory than those of 1855, since they show that whilst the instruction has extended to a larger number, the rate of success is lower; 25 per cent. taking prizes this year against 38 per cent. in 1855. On the other hand, success has not been so much confined to the first papers, freehand and geometry, as before, a larger number of successful papers having been worked in perspective, object drawing, and drawing from memory.

Many students have been unsuccessful in freehand drawing from a want of method in beginning; they have finished, or partially finished, their drawings piece by piece, neglecting to obtain

the general proportions of the parts, which should have been their first care. In one school, the marks are lower than they would otherwise have been, because the drawings from the solid model are not representations of the object, as actually seen by the student, but recollections of some previous exercise.

In drawing from memory, many candidates work from a recollection of a drawing or print of the object required, instead of drawing from a remembrance of the thing itself; this is nearly always perceived by the examiner, when lower marks are given in consequence. These examinations have been rendered much more effective and accurate as tests of progress, by the adoption of Mr. Redgrave's suggestion that the four or five papers should be distributed separately, one hour being allowed for each, so that no one student could have more time for any paper than another, whereas, previously, the whole set of papers having been given out together, a student, by neglecting two or three, could work more than one hour on a single paper, thus giving an inequality to the results which made a fair comparison extremely difficult. This change has probably had some influence in altering the proportion of prizes obtained in the several different papers. In the choice and arrangement of the object used as an example for filling the fourth paper, some improvement might perhaps be made. It is, I think, not desirable that the subject chosen should so frequently be one of the models used in actual teaching, since, by constant repetition, they are drawn by rote, and do not afford so efficient a test of the power of seeing and drawing, as an object less familiar to the student would do.

I have, &c.

H. A. Bowler,

Inspector for Art.

The Secretary of the
Department of Science and Art.

Report on the Schools of Art inspected by R. G. Wylde during the Year 1856.

Sir,

In considering the results of the inspection of the Schools visited by me this year, due regard must be had to the fact that a new method of examination was for the first time established. The schools which were visited in the earlier part of the year had, in consequence of their having forwarded works in the usual manner to the examination in London in the previous December, but very little time to prepare works for competition. This disadvantage was unavoidable, as it was necessary that the duties of inspection should commence early in the year, in order that all the schools might be examined before the annual national competition should take place. In future years this inequality will not again occur, as in all the schools a year will elapse before they are revisited for the purpose of a general examination.

The powers of the students in practical geometry, perspective, model and mechanical drawing, are now tested by exercises worked in the presence of the Inspector, instead of, as formerly, by forwarding drawings and diagrams to the exhibition of students' works in London. The present system has proved advantageous in providing a better test of efficiency; as in one or two instances I have found that students who had already obtained medals in those subjects, awarded to them for the diagrams which they had forwarded to London, were unable to solve the papers set before them under the new plan of inspection, proving that they had on former occasions merely copied the diagrams, without understanding the principles. I find also that the mere fact of holding an examination on these subjects in the school itself excites an interest for them amongst the students, and induces them to study them with more particular attention, when they find that by so doing they are likely to gain prizes of use to them in the prosecution of their studies.

All the schools I have visited this year are of comparatively recent establishment, and, as may be expected, the works produced in them, with some few exceptions, do not reach the same standard of excellence as those in the old established schools. In the smaller and more remote towns, students have little opportunity of seeing good works of art, and can only form their estimate of excellence from what they have immediately before them. The exhibition of the Prize Drawings in the different schools was therefore in this respect of great value to the students, by showing them what was done in other schools; but still, as they remain but a few days in one place, the student can at best but retain a remembrance of them, which soon wears off. It will therefore be a great boon when the schools possess, as is contemplated, a standard set of drawings of the Examples in each stage.

Appendix D. Report on Schools of Art.

The return in the Appendix (p. 200,) shows the number of Medals and Prizes awarded in the different schools, and the date of the Inspector's visit.

In the four subjects, namely, geometry, perspective, model and mechanical drawing, in which examinations, open to students in the Schools of Art, were held by me, whilst 60 students were successful in model drawing, and 38 in geometry, only 9 succeeded in perspective, and 7 in mechanical drawing; the successful students with one exception, being students in the schools at Exeter, Penzance, and Southampton.

Elementary Instruction.

One of the most important features in the working of the schools this year has been the principle adopted by the Department, of holding examinations in drawing, in the several localities where Schools of Art have been established, open to *all* who choose to present themselves for examination. These examinations are of two grades. In the first grade the students are required to copy some very simple outline of an object or form which is set before them; and all who attain a fair standard of accuracy obtain a reward, usually a drawing board and T square, or a case of drawing instruments, which carries with it also a small payment to the master of the School of Art. In the second grade the exercises are more difficult, being the same as those used in the examination of pupil-teachers and students in training colleges; and as a higher standard of excellence is required, the reward is proportionately more valuable. The subject of this year's examination was free-hand drawing; but it is proposed to extend it to geometry, perspective, model and memory drawing. (*See* Paper No. 232, page 24.)

The accompanying Table shows the names of those towns in which examinations in elementary instruction have been held, and the results:—

Name of Town.	First Grade Examination.			Second Grade Examination.		
	Number examined.	Number of Prizes awarded.	Per-centage who obtain Prizes.	Number examined.	Number of Prizes awarded.	Per-centage who obtain Prizes.
Swansea - -	43	16	·37	53	16	·30
Carmarthen - -	34	9	·27	14	8	·57
Chester - -	615	69	·11	60	7	·12
Birkenhead - -	90	23	·26	10	5	·50
Hereford - -	175	54	·31	6	1	·17
Wolverhampton -	63	26	·41	2	1	·50
Warrington - -	180	35	·20	10	4	·40
	1,200	232	·20	155	42	·27

It will be seen that 1,200 students presented themselves for examination in the first grade, of whom 232, or 20 per cent. of the number examined, succeeded in obtaining rewards. In the second grade, 155 were examined, of whom 42, or 27 per cent., obtained rewards.

The efficiency of the instruction afforded in the above towns must not be judged by the column indicating the per-centage of those who obtain rewards. According to the return, Wolverhampton would appear to most advantage, as 41 per cent. of those examined in the first grade were successful, whereas at Chester the number is only 11 per cent. But it must be taken into consideration that at Wolverhampton, a town with 120,000 inhabitants, only 63 were examined, the candidates being a selection from the two schools instructed by the master of the School of Art; whereas at Chester, with a population of 27,700, the number examined was 615, of whom 69 obtained prizes. In the latter case, however, all of the children in the different schools instructed by the master attended the examination, instead of, as is more desirable, a selection only of the more advanced from each school.

These public examinations will, I am convinced, have a great influence on the future prosperity of the Schools of Art established in the towns where they have been held, by disseminating a taste for drawing amongst the children of the National schools, who, after leaving school, will continue to prosecute their studies at the School of Art. The effect may not show itself for some time, but eventually the evening classes in the central schools will be principally composed of students who have received the rudiments of instruction in the National schools. This is already the case in several of the schools I have visited. At Hereford, and also at Warrington, some of the most promising students were formerly instructed in the public schools. I feel sure that in all those towns where a large number of children are receiving sound elementary instruction, the School of Art in that town will in proportion derive benefit and become a success.

I have, &c.

R. G. Wylde,

Inspector for Art.

The Secretary of the
Department of Science and Art.

Notice of the Course of Examination for Candidates for Certificates in Art. Second Session, 1856.

No. 198.

1. The candidates will assemble in the class lecture-room, at Marlborough House, on Monday, the 14th of July, at 10 o'clock in the morning. At half-past 10 o'clock the first paper will be given out, and the examinations in the various groups will continue at the days and at the times appointed below.

2. The use of any books or notes is, of course, strictly psohibited in the examination-room; any candidate having notes in his possession is re-

Appendix D. REPORT ON EXAMINATION FOR CERTIFICATES.

quired to give them up to the Attendant-Examiner before the papers are distributed.

3. When each paper is given out the door will be closed until the time allowed for the paper is ended, and the papers gathered in.

4. Each candidate is required to adopt a private mark consisting of some combination of any two letters and two figures, thus (AG.51.), with which to sign his papers.

5. This private mark, together with the name of the candidate who has adopted it, will be placed in a sealed envelope and delivered to the examiner after the completion of the first paper. The candidate will continue using the same mark throughout the examinations.

6. No kind of explanation can be given of any paper delivered to the candidates.

7. Candidates are strictly forbidden to assist each other in any possible way during the examination.

8. Candidates who have not prepared their probationary works for Group I, in the Training School, will be required to execute some prescribed work, in order to verify them, in the presence of the examiner, beyond the general papers and works for the group.

9. This paper is to be read aloud when the candidates first assemble, and a copy posted in the room where the examination takes place.

Examination Time List. Second Session, 1856.

Monday, 14th July.

10½	to 12½	Geometrical paper	- - - -	Group	1
12½	„ 2½	1st Perspective paper	- - - -	„	1
2¾	„ 4¾	2nd Perspective paper	- - - -	„	1

Tuesday, 15th July.

10	„ 12	Mechanical drawing	- - - -	„	1
12½	„ 2½	Architectural drawing	- - - -	„	1
2½	„ 4½	Model drawing	- - - -	„	1

Wednesday, 16th July.

10	„ 12	Paper on ornament	- - - -	„	2
10	„ 12	Paper on ornament	- - - -	„	4
12	„ 1	Time sketches, ornament	- - -	„	2
12	„ 1	Time sketches, ornament	- - -	„	4
10	„ 1	Advanced mechanical drawing	- -	„	6
1½	„ 3½	Paper on colour	- - - -	„	1
1½	„ 3½	Botany	- - - -	„	
1½	„ 3½	Paper on anatomy	- - - -	„	3
1½	„ 3½	Paper on anatomy	- - - -	„	6
3½	„ 4½	Sketch of muscles	- - - -	„	3
1½	„ 4½	Sketch of ornament	- - - -	„	1

Candidates whose works have not been executed in the Training School.

The advanced mechanical drawing paper will be given out this day at 1 o'clock, and called in this day week at the same hour.

Thursday, 17th July.

10	„ 2	Colour sketch	- - - -	Group	2
10	„ 1	Model of ornament	- - - -	„	4
1	„ 5	{ Model in low relief / Anatomically analysed }	- - -	„	5

Friday, 18th July.

12	„	4	Living model - - - -	Groups 3 & 4	
10½	„	12	2nd paper on ornament - -	Group 2	
10½	„	12	2nd paper on ornament - - -	„	4

An examination in general knowledge will be held at a time to be hereafter named.

No. 199.—EXAMINATION PAPER, No. 1.

Geometry.

1. On a line 2 inches long as a base, construct a right angled triangle, making the acute angle, at one end of the base line, one of 30°.
2. About a circle of 2 inches diameter describe a triangle similar to the above.
3. On a line 1½ inches long construct a heptagon.
4. On each side of a line 5 inches long as a transverse diameter, describe a semi-ellipse. Let the semi-conjugate diameter of one be 2 inches long, of the other 1½ inches; and use different methods of construction for each.
5. At any point of the circumference of either of the above semi-ellipses, except the extremities of the diameter, draw a tangent to the curve, and at some other point, not the extremities of the diameters, draw a perpendicular to the curve.
6. Find a *mean* proportional line to two lines, one being 4½ inches, and the other 2 inches long.
7. Transpose a square having sides of 2 inches into an equilateral triangle having the same area.

Note.—These diagrams are to be neatly and accurately drawn, and the constructing lines shown, but written descriptions are not necessary.

Two hours allowed for this paper.

No. 200.—EXAMINATION PAPER, No. 2.

Perspective.—Group 1.

1. State the general difference between the appearance and the known facts of an object.
2. Explain the cause of the difference between the *appearance* and the *facts* of an object.
3. Name the planes employed in perspective representations, and explain their connexion with planes in nature.
4. Name the points used in perspective, and their relation to each other.
5. Illustrate by small but neat drawings the processes by which vanishing points and their measuring points are found, whether lying on original or inclined planes, and explain the process in writing.
6. Give reasons for the importance of the base of the cone of rays.

Two hours allowed for this paper.

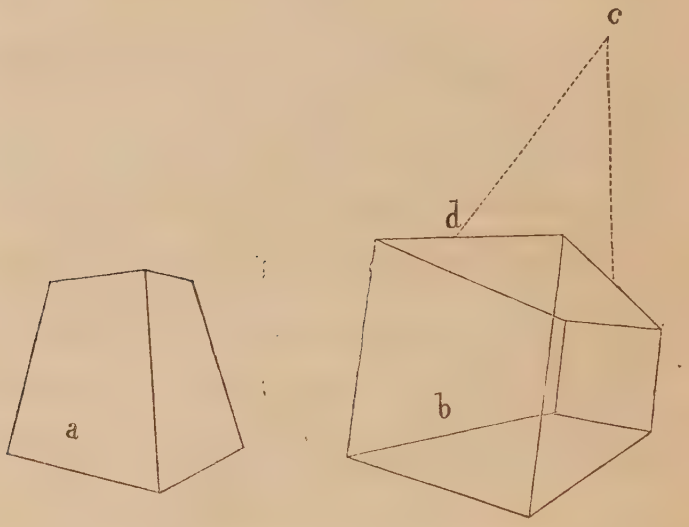
Appendix D.

REPORT ON EXAMINATION FOR CERTIFICATES.

No. 204.—EXAMINATION PAPER, No. 3.

Perspective.—Group 1.

These problems are to be worked to a scale of $\frac{1}{2}$ an inch to a foot. The distance of the spectator from the picture being in each case 12 feet, and his horizon 5 feet 6 inches above the horizontal plane upon which the objects and the picture stand.



1. On the ground plane 2 feet to the left of the centre of vision, and 3 feet within the picture, place the nearest angle of a truncated pyramid, as at *a*; its sides making angles of 60° and 30° to the plane of the picture; its base to be 6 feet square, its height 8 feet, and the top 3 feet square.

2. On the ground plane 2 feet to the right of the centre of vision, and 2 feet within the picture, place the nearest side of a similar pyramid, lying on the ground, as at *b*; its rectangular base making an angle of 45° with the plane of the picture.

3. From a point 12 feet above the centre of the top edge of the distant extremity of the last figure, as at *c*, draw a line through the centre of the top edge of the nearest end, as at *d*, and produce it to cut the ground plane; measure and state in figures its length.

Note.—These diagrams to be neatly and accurately drawn, and the constructing lines shown.

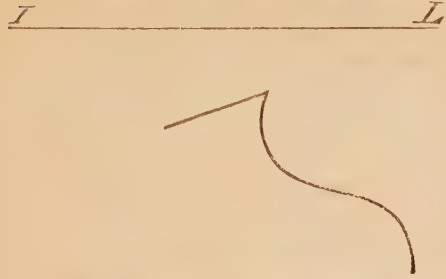
Two hours allowed for this paper.

No. 201.—EXAMINATION PAPER, No. 3.

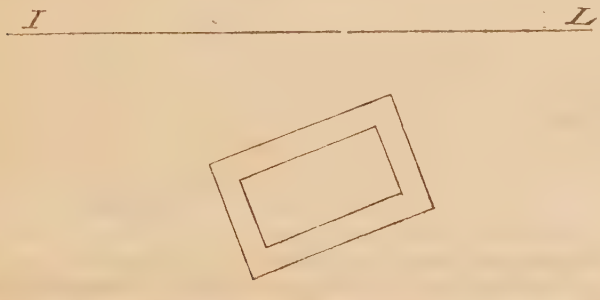
Mechanical Drawing.—Group 1.

1. A piece of wood 3 inches long and 1 inch square makes an angle of 60° with the upper plane, but is parallel with the lower plane of projection. Required, its elevation.

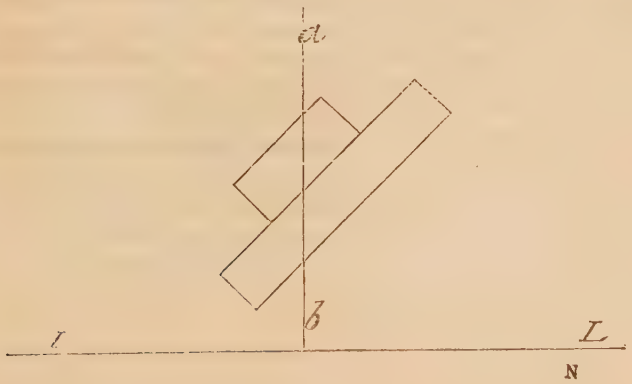
2. Upon an inclined plane that makes an angle of 25° with the intersecting line, find the projection of the accompanying figure, representing a right line in combination with a curved line.



3. Find, with the fewest possible number of points, upon an inclined plane of 30°, the projection of the annexed figure representing a rectangular frame 4 inches long and 2½ inches wide, made of ½ inch square wood.



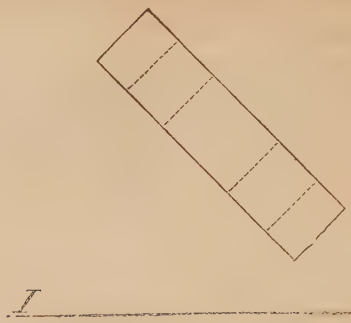
4. Required, a sectional elevation taken through the line *a b* of the accompanying figure representing a cylinder of two dimensions, the diameters being 3 inches and 4½ inches respectively, and the thickness of each 1 inch.



Appendix D.

REPORT ON EXAMINATION FOR CERTIFICATES.

5. The annexed figure represents a cylindrical block of wood 3 inches diameter and 1½ inches thick perforated with an hexagonal hole 2 inches diameter measured across the angles. Required, a plan of the same.



No. 226.—EXAMINATION PAPER, No. 5.

Botany.—Group 1.

1. Name and describe the primary divisions of the vegetable kingdom, explaining wherein they differ from each other in germination, growth, &c.

2. Name and describe the various parts distinguished in a flower.

3. Describe the different modes of inflorescence, as single flowers, or as combined in groups of various kinds.

4. Describe the principle arrangements of leaves, and hence of buds, branches, &c.

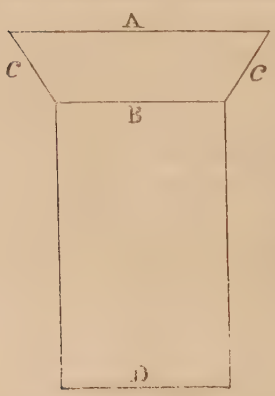
No. 214.—EXAMINATION PAPER, No. 6.

Architectural Drawing.—Group 1.

1. What are the three principal mechanical actions to which building materials are subjected?

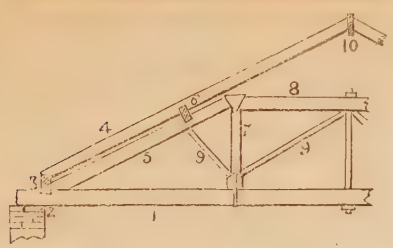
2. Name the two kinds of bond common in brickwork, and draw in elevation, one quarter full size, the arrangements of the bricks in each case, giving the technical names for the ends and sides of the bricks.

3. To a scale of 1 inch to a foot, draw an oblong which shall represent a window space 6 feet high and 3 feet 6 inches wide; the wall above it to be carried by a *straight* brick arch 1 foot 6 inches deep; give the names of the upper and under sides of the same at *A* and *B*, and also those at *c* and *c*: the lines *c c* forming an angle of 60° with each other. Find the centre, and describe an arc showing the line of pressure in the arch. Below the opening show an inverted or discharging brick arch, the crown of which is 4 feet below the line *D*, and 9 inches deep, show how the bricks would be laid and state the object of these arches.



4. Explain by sketch the position of timbers used in single and also double framed floors, and give their names.

5. Give the names of all the timbers in this truss, and state which are in compression and which in tension.



No. 147.—Examination Paper, No. 7.

Colour.—Group 1.

1. Light being in itself colourless, how are coloured rays produced?
2. What is the difference between colours and pigments?
3. Why are certain colours called elementary or primary colours?
4. Do the different primary colours bear any relative proportion to white light and to each other?
5. What is the nature of complementary colours?
6. What are the peculiar properties of red, of blue, and of yellow?
7. Describe the secondary colours, the mixtures that produce them, and their relative proportions to the primaries.
8. How are tertiary colours produced, and what are their proportionate relations to the primaries and secondaries?
9. When light and dark surfaces are juxtaposed, what sensible influence is perceptible?
10. When coloured hues are juxtaposed, what is the apparent change produced on each when the hues are complementary?
11. What is the effect when the colours juxtaposed are non-complementary?
12. If two hues are diapered over a given surface, and we interpose a white line around the forms, what effect will be produced upon each hue?
13. Wha in the same case willbe the effect of a black line?
14. Explain what is meant by "glazing," by "scumbling," by thick and thin painting?
15. Describe the optical effect called the "occular spectrum," and explain it.
16. What water-colour pigments mixed together would produce purple?
17. What mixtures would produce orange?
18. What pigments in water-colours would give the best tints for clouds, and for skies at mid-day?
19. What mixtures would produce a good grey?
20. Fill up the blank outline appended with full hues of primary, secondary, and tertiary colour, into those figures which appear to you to give proper surface proportions for each hue.

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No. 194.—EXAMINATION PAPER, No. 1.

Surface Ornament.—Group 2.

1. Describe the manner of adapting vegetable forms to ornamental art, from ancient Egyptian examples.

2. What are the characteristic types of Greek ornament?

3. In the Greco-Roman style (Pompeian) what are the characteristics of the painted wall decorations?

4. What are the principal types of Chinese ornament?

5. Describe the peculiarity of the Chinese fret ornament, as distinguished from the frets of other styles.

6. What are the characteristic types in Indian ornament?

7. Describe one of the types most peculiar to surface-decoration, but rarely used in Indian relief-ornament.

8. What are the ornaments used in the ornamentation of mouldings in Hindu architecture?

9. Describe the characteristics of Mohammadan ornament.

10. Characterise the early and late Mohammadan styles.

11. Describe the characteristic of the fret ornament used by the Mohammadans.

12. Describe ornament used in manuscripts, &c., by the modern Persians.

13. Describe the characteristics of surface-decoration in the Romanesque style used in the Basilicas in the decoration of architecture and in church furniture. (Episcopal thrones, the ambo, &c.)

14. Describe from examples of Italian Gothic of the 13th and 14th century the manner of combining ornamental and fine art in wall decoration.

15. Illustrate from specimens of German Gothic what are the characteristics of the tracery and of canopies adapted for surface-decoration, painted glass, wall painting, &c., as distinguished from tracery and canopies in relief.

Two hours allowed for this paper and one for sketches.

No. 215.—EXAMINATION PAPER, No. 4.

Surface Decoration.—Group 2.

1. In the antique Greek vases, from the indication of ornament shown in the draperies of the figures—what are the inferences to be made as regards ornamental art applied to textile fabrics (costume).

2. In mediæval art (in wall decoration or figure drapery in paintings) what are the principles to be observed in ornamental design for painted or stencilled decoration of walls, or in printed wall paper, or woven fabrics for hangings, &c.

3. State what are the principles to be derived from ancient or mediæval styles for the adaptation of natural forms to technical ornament, either for weaving, printing, stencilling, embroidery, ceramic art, or any other process of which you are acquainted.

4. What are the characteristics of ornament adapted for floors, tesselated pavements, carpets, &c.?

One hour and a half allowed for this paper.

No. 193.—EXAMINATION PAPER, No. 1.

Anatomy.—Groups 3 and 5.

1. Describe the clavicle and its connexions with other bones. How would you distinguish one clavicle from the other?
2. What is meant by the arch of the foot? Name the bones of which it consists, and the order in which they are arranged from behind forwards.
3. What parts form the framework of the thorax?
4. What is the general shape of the thoracic framework? What parts of it are recognizable in the surface-forms, and what parts are concealed?
5. What kind of joints are those found in the hand beyond the wrist? What movements do they possess?
6. Describe the great pectoral muscle; its situation, shape, attachments, and use.
7. Give briefly the structure, properties, and uses of the tendons.
8. In the living body, how are the surface-forms affected by muscles, and how by tendons, during muscular action? Give any illustration which occurs to you.
9. What muscles extend the leg in walking; and what muscles raise the heel from the ground in standing on the toes.

Two hours allowed for this paper.

No. 197.—EXAMINATION PAPER, No. 1.

Relief Ornament.—Group 4.

1. What are the chief characteristics of ancient Egyptian ornament?
2. Give the characteristic of Greek sculptured ornament as distinguished from painted or surface.
3. Describe the character of early and late Roman foliage.
4. Describe the decorative features of Chinese architecture.
5. Describe some of the chief characteristic types of Chinese ornament.
6. Describe some of the ornamental details of Hindu architecture.
7. What are the divisions or sub-styles of Italian mediæval art?
8. What are the characteristic details of mediæval Italian?
9. What is the characteristic feature of late German Gothic mouldings?
10. What are the characteristics of the late French Gothic (Flamboyant)?
11. Describe the transition from the Gothic to the (Cinquecento) revival of classic architecture in Italy.
12. Describe the transition from the Gothic to the Renaissance in France.
13. Describe the French style of ornament of the time of Louis XIV.
14. Describe the English ornament of the time of James I.

Two hours allowed for this paper, and one for sketches.

No. 225.—EXAMINATION PAPER, No. 2.

Relief Ornament.—Group 4.

1. Describe the peculiar features of relief ornament adapted for wood carving, as distinguished from surface ornament; and give examples from any of the antique, mediæval, or modern styles.
2. Describe the peculiar features of relief ornament adapted for stone carving in any of the above styles.
3. The bronzes of Herculaneum and Pompeii afford good examples of ornament adapted for casting; describe the technical characteristics of the ornament.

Appendix D. — Report on Examination for Certificates.

4. From various mediæval examples of wrought ironwork, describe in what the ornament differs from ornament designed for casting in iron or bronze.

One hour and a half allowed for this paper.

No. 205.—Examination Paper, No. 2.

Mechanical Drawing.—Group 6.

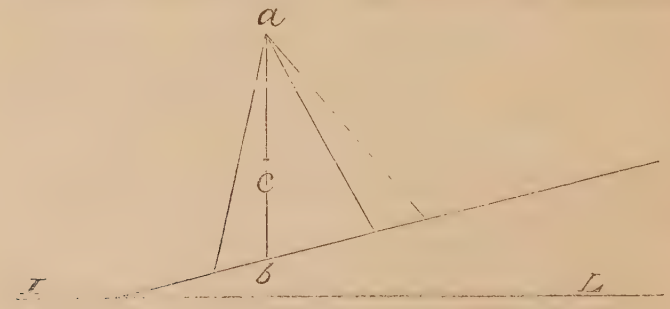
Required,—the end elevation of a power loom, the drawing to be made from actual measurement, and to scale.

Four days will be allowed for this paper.

No. 203.—Examination Paper, No. 1.

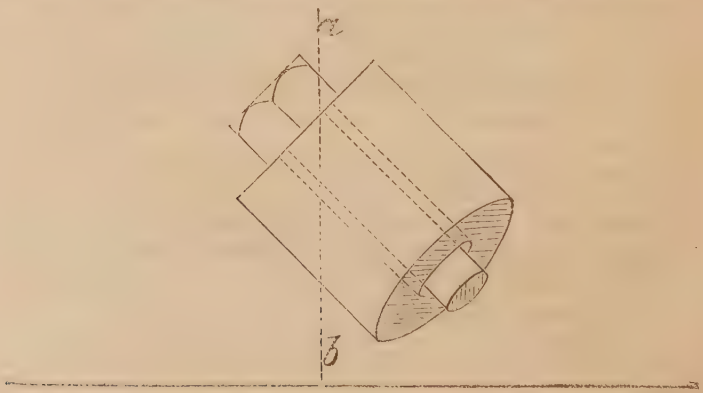
Mechanical Drawing.—Group 6.

1. Describe the various modes for finding the plan of any given point *c* in the line *a b* of an hexagonal pyramid, when such line *a b* is in the vertical plane, or at right angles to the intersecting line.

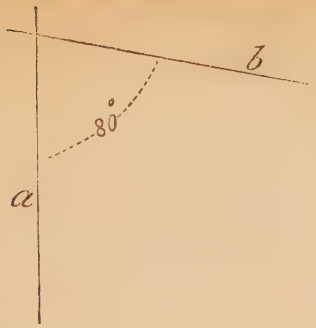


2. Required,—the elevation or projection of a cube with one of its diagonals in the vertical plane, that is, at right angles to the intersecting line, and parallel to the plane of projection.

3. The annexed figure represents the elevation of an hexagonal nut with a ¾-inch bolt passing through a round boss or cylinder 2 inches diameter. Required,—a sectional elevation taken through the line *a b*.

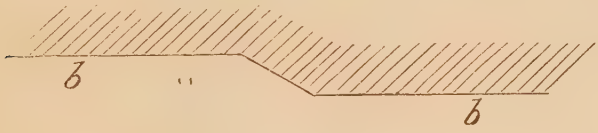


4. Two shafts *a* and *b* make with each other an angle of 80°. It is required to communicate motion from *a* to *b* by a pair of bevel wheels; the diameter of wheel on shaft *a* = 3′ 6″, and on shaft *b* 2′ 3″. Required,—the true form or bevel of the wheels for that purpose. Scale, 1½ inch to the foot.



5. What are the proportions that have been given for the teeth of wheels.

6. *A* in the accompanying figure represents a plan of a square prism or block of wood; and *b* a sectional plan of a wall. Required, the elevation and projection of the shadow cast by *A* upon the wall *b*.



Three hours allowed for this paper.

Examinations for Art Certificates.

February 1856.

List of Persons to whom Certificates were granted :—

Group 1.

Godfrey Sykes.
Lionel Legge.
James Waite.
John Rowe.
John Colson.
George Wardle.
W. H. Sounes.
J. A. Mulligan.
J. Bentley.
John Lord.
Catherine Wilson.

Group 2.

J. B. Williamson.
John Kennedy.
Charles Hodder.
Eliza Mills.
Florence Collins.

Group 3.

George Newton.

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REPORT ON EXAMINATION FOR CERTIFICATES.

Group 4.
C. H. Whitaker.
Thomas Arthur.
J. C. Swallow.

Group 5.
C. H. Whitaker.

Group 6.
James Brenan.
J. Bacon.
E. Lyne.
A. N. Brooke.

July 1856.

Group 1.
R. Harley.
John Hill.
Archibald Gunn.
Joseph Bacon.
James Carter.
W. A. Morley.
Vernon Howard.
John Randall.
Catherine Baines.
D. F. Surenne.

Group 2.
William Pozzi.
Susan Ashworth.
G. P. Yeats.

Group 6.
Edward Shiel.
George Atkinson.
Hugues Protat.

Appendix D.

REPORT ON EXAMINATION FOR CERTIFICATES.

EXAMINATIONS held by the INSPECTORS throughout the UNITED KINGDOM, showing DATE of VISIT, NUMBER of STUDENTS EXAMINED, and NUMBER of AWARDS.

Name of School.	Date of Visit.	Number of Medals awarded.	Examination in 2nd Grade.		Examination in 1st Grade.	
			Number Examined.	Number of Prizes awarded.	Number Examined.	Number of Prizes awarded.
Aberdeen	3d June	5	17	9	.	.
Bath	28th April	4	30	4	.	.
Belfast	15th October	3	.	.	97	7
Birkenhead	2d October	4	20	9	90	23
Birmingham	Not examined in the Year.	.	.	.	.	.
Bolton	New School.	.	.	.	.	.
Bristol	5th May	4	20	8	.	.
Carlisle	19th May	4	.	.	.	.
Carmarthen	11th August	.	14	8	34	12
Carnarvon	20th June	3	14	2	73	24
Cheltenham	10th May	10	41	15	.	.
Chester	30th September	3	80	18	615	69
Clonmel	27th October	2	10	1	40	14
Cork	21st October	14	30	9	100	4
Coventry	15th September	18	18	10	85	40
Dublin	6th October	14	20	17	.	.
„ Lace School	10thOctober	15	.	.	.	.
Dudley	3d October	5	2	1	100	33
Dundee	5th June	8	.	.	.	.
Dunfermline	10th June	1	.	.	.	.
Durham	5th May	8	.	.	.	.
Exeter	19th May	8	.	2	.	.
Glasgow	14th June.	25	6	3	.	.
Hampshire District	Not examined in the Year.	.	.	.	.	.
Hereford	3d November	9	6	1	175	54
Leeds	28th April.	3	.	.	.	.
Lancaster	New School.	.	.	.	.	.
Limerick	16th October	7	15	6	12	4
Liverpool	14th June	13	200	54	654	271
Macclesfield	Not examined in the Year.	.	.	.	.	.
Manchester	1st December	30	129	41	419	113
Newcastle-on-Tyne	12th May	13	12	4	.	.
Norwich	20th November.	.	.	19	179	67
„ (Yarmouth)	24th November.	1	29	16	46	27
Nottingham	Not examined in the Year.	.	.	.	.	.
Oxford (Culham)	. . . .	.	.	.	.	.
Paisley	22d June	15	.	.	.	.
Penzance	5th June	10	45	10	.	.
Petersfield	New School.	.	.	.	.	.
Plymouth	15th June.	2	.	11	.	.
Potteries:— Burslem, Hanley, Newcastle-under-Lyme, Stoke	Not examined in the Year.	.	.	.	.	.
Sheffield	8th December	28	32	14	.	.
Southampton	23d June	3	.	12	.	.
Stourbridge	26th September.	3	.	.	70	35
Swansea	4th August	0	53	16	43	16
Tavistock	10th June.	5	.	.	.	.
Taunton	New School.	.	.	.	.	.
Truro	31st May	5	.	5	.	.
Warrington	8th November	23	10	4	180	35
Waterford	26th October	7	20	5	30	3
Wenlock & Coalbrookdale	New School.	.	.	.	.	.
Wolverhampton	10th November.	7	2	1	63	26
Worcester	20th September.	25	25	11	45	28
York	. . . .	.	.	.	.	.

Appendix D.

EXAMINATION IN DRAWING IN TRAINING SCHOOLS.

RESULTS of EXAMINATION in Drawing of Schoolmasters, Schoolmistresses, or Students in Training Schools. December 1856.

Name of Training School.	Successful Papers worked in					Certificates Granted.	Prizes Awarded.	Number Examined.	Proportion.
	Free Hand Drawing.	Geometry.	Perspective.	Model Drawing.	Memory Drawing.				
Battersea	18	14	8	12	9	1	39	125	·31
Bishop Stortford	2	..	..	1	..	..	3	38	·08
Brighton	..	..	..	1	..	..	1	22	·05
Borough Road	8	39	31	7	3	..	47	143	·32
Carmarthen	4	4	..	1	1	..	7	37	·19
Carnarvon	2	5	5	5	3	..	8	34	·23
Cheltenham	12	12	19	8	9	3	34	179	·19
Chester	6	20	22	6	9	6	27	52	·52
Chichester	..	2	2	1	..	..	4	11	·36
Culham	4	14	4	3	3	..	13	36	·36
Derby	2	..	..	3	..	..	5	39	·13
Durham	2	6	6	2	4	1	10	31	·32
Exeter	8	12	7	6	3	4	17	46	·37
Fishponds (Bristol)	3	5	..	..	1	..	6	27	·22
Hammersmith, R. C.	3	5	2	1	1	1	5	15	·33
Highbury	17	24	24	8	7	3	38	76	·50
Home and Colonial	5	2	..	4	1	..	8	84	·09
Liverpool	..	..	..	..	..	..	..	24	..
Norwich	..	..	..	..	..	..	..	19	..
Salisbury	3	..	..	1	1	..	3	47	·06
Saltley (Worcester)	8	9	4	6	2	2	14	25	·56
St. Leonard's	..	12	..	..	..	..	12	12	1·00
St. Mark's (Chelsea)	7	6	4	5	7	1	17	104	·16
Warrington	10	1	2	..	1	..	12	63	·19
Westminster, Wesleyan	22	20	9	3	8	2	29	123	·23
Whitelands	12	1	4	2	3	..	19	109	·17
Winchester	1	..	..	2	1	..	2	21	·09
York	12	6	7	4	6	2	19	80	·23
	171	219	160	92	83	26	399	1,622	·24
South Kensington	6	5	10	9	13	7	17	24	·70
Total	177	224	170	101	96	33	416	1,646	·25

APPENDIX E

Appendix E.

LOCAL SCHOOLS OF SCIENCE.

Name of Place.	Date of Establishment.	Population in 1851.	Total Number receiving Instruction in 1855.	Total Number receiving Instruction in 1856.	Chairman.	Secretary.	Master or Masters.
Aberdeen :—							
Science School .	1854	71,973	140	200	Westland, J. .	Yeats, Alex.	Profs. Brazier & Brown.
Navigation School*	1856		. .	. .	. .	,,	Henessey, G. .
Birmingham .	. .	. .	260	1,039	Ryland, A. .	. .	Williams . .
Bristol :—							
Trade School .	1856	137,328	55	110	Bp. of Glouces-ter and Bristol.	Wilkson, W.	Coomber, Thos.
Mining School .	1855	. .	. .	15	Bennet, Henry	Cossham, H.	Tryas, Mark .
Dublin :—							
Museum Irish Industry.	. .	147,506	1,064	1,547	Kane, Sir R. .	. .	Profs. Jukes, Sullivan, Barker, and Hervey.
Royal Dublin Society.	. .		1,066	1,038	Duke of Leinster.	Steele, Dr. .	Profs. Davy and Scouler.
Committee of Lectures.	. .		1,719	2,165	The Lord Chancellor.	Dr. Ball .	Various Lecturers.
Edinburgh :—							
Technological Museum.	1855	160,302	40	52	Wilson, Prof. G.	. .	The Director .
Hull :—							
Navigation School	1785	84,690	162	170	Whitaker, Capt.	Wilson, E. S.	Scaping, Z.; Salmon, W. R.
Leeds :—							
Science School .	1854	171,805	176	187	Wilson, T. .	Mc Ivor, A. .	McIvor, A. . .
Leith :—							
Navigation School	1855	30,919	74†	210	Provost Taylor	Thomson, Rev. J.	Newton, J.; Morris, M.
Liverpool :—							
Navigation School	1853	375,955	819	1,241	Tinne, J. A. .	Towson, J. J.	Smart, H. J.
London :—							
School of Mines	1851	2,362,236	86	59	Murchison, Sir R. I.	Reeks, T. .	Profs. Hofmann, Stokes, Willis, Ramsay, Percy Huxley, Smyth
Working Men's Lectures.	. .		2,400	1,800	,,	,,	. . . .
Royal College of Chemistry and Metallurgical Laboratory.	. .		128	132	,,	,,	Dr. Hofmann, and Dr. Percy
Navigation School, Well Street.	. .		358	437	Admiral Bowles	Pearce, Capt.	Hughes, E.
Navigation and Trade School, Poplar and Blackwall.	1856		80	244	Green, Richard	Furnell, Jas.	Bolt, W. H.; Buckmaster, J. C.; Swinstead, C.
Newcastle :—							
Trade School .	1856	80,000	. .	110	Moody. Rev. C.	Moody, Rev. C.	Thorn, T. H. .
Stoke and Potteries:							
Science School .	1855	84,027	274	322§	Outrim, George	Crewe, A. .	Leech, Thomas
Sunderland :—							
Navigation School	1855	67,394	103‡	439	The Mayor .	Fairly, R. .	Stiles, J. J.; Wes W. T.
Truro :—							
Mining School.	1855	10,733	6	15	Tweedy, W. M.	Bond, W. H.	. . . .
Wandsworth :—							
Trade School .	1854	10,000	118	129	Booth, Dr. .	Coleman, A	Marks, R.; Buckmaster, J. C.; Hagreen, H. B
Waterford :—							
Navigation School	. .	. .	. .	. .	. .	. .	. . . .

* Opened in December 1856.

† This is a free school, but is open to one or two paying pupils in addition to the number on th foundation.

Classes.						Pupil Teachers.	Expenditure on Account of Examples during the Year 1856.			Total Sum received in Fees from the Students, 1856.			Name of Place.
Morning.			Evening.										
No. of Lessons per Week.	Average Attendance.	Rate of Fees.	No. of Lessons per Week.	Average Attendance.	Rate of Fees.		£	*s.*	*d.*	£	*s.*	*d.*	
3	20	15*s.* per quarter.	4	65	2*s.* 6*d.* and 2*s.*	2	1	7	9	113	13	9	Aberdeen :— Science School.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Navigation School.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Birmingham.
60	61	4*d.*, 6*d.*, and 1*s.*	2	30	3*d.* per evening.	.	163	19	6	46	12	3	Bristol :— Trade School.
. .	15	8*d.* per week	2	8	4*d.* per lesson.	.	20	0	0	20	0	0	Mining School.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Dublin :— Museum Irish Industry.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Royal Dublin Society.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Committee of Lectures.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Edinburgh :— Technological Museum
72	94	. .	5	9	5*d.*, 2*s.* 6*d.*, and 6*d.*	2	3	12	2	4	1	6†	Hull :— NavigationSchool.
5	157	. .	2	32	4*s.* per quarter, and 6*s.* 6*d.* per quarter.	.	10	8	0	.	.	.	Leeds :— Science School.
6	31	6*d.*,1*s.*,2*s.*6*d.*, and 5*s.* per week.	5	24	6*d.* and 1*s.* per week.	.	.	.	.	55	17	0	Leith :— NavigationSchool.
6	20	6*s.* per week	5	22	6*d.* per week.	.	.	.	.	367	7	6	Liverpool :— NavigationSchool.
. .	. .	. .	. .	.	. .	.	.	.	.	.	.	.	London :— School of Mines.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Working Men's Lectures.
. .	. .	6*s.* per week	. .	. .	6*d.* per week	.	.	.	.	73	11	6	Royal College of Chemistry and Metallurgical Laboratory.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Navigation School, Well Street.
6	74	6*s.* per week	18	51	4*s.* per month.	.	.	.	.	143	4	0	Navigation and Trade School, Poplar and Blackwall.
33	60	6*d.* and 4*d.* per week.	. .	. .	. .	1	25	5	4	56	3	8	Newcastle :— Trade School.
1	9	10*s.* per course.	9	73	£2 per annum.	.	.	.	.	101	0	0	Stoke and Potteries : Science School.
. .	. .	5*s.*, 2*s.* 6*d.*, and 6*d.* per week.	. .	. .	1*s.* per week	.	.	.	.	74	5	6	Sunderland :— NavigationSchool.
15	15	£12 per annum.	. .	. .	. .	.	.	.	.	.	.	.	Truro :— Mining School.
. .	75	8*d.*, 1*s.*	. .	. .	. .	2	.	.	.	130	14	0	Wandsworth :— Trade School.
. .	. .	. .	. .	. .	. .	.	.	.	.	.	.	.	Waterford :— NavigationSchool.

‡ Opened in September. § This includes the attendance at two short Courses of Lectures.
‖ Placed under inspection in December, by the Irish Board of Education.

Name of Place.	Date of Establishment.	Population in 1851.	Total Number of Persons receiving Instruction in Drawing in the Year ending June 1855.	Total Number of Persons receiving Instruction in Drawing in the Year ending June 1856.	Total Sum received in Fees from Students. £ s. d.
Aberdeen (Mech. Instn.)	1853	71,973	796	656	140 7 8½
Bath	1854	54,240	. .	852	. .
Belfast (Phil. Instn.)	1850	99,660	160	142	108 17 2
Birkenhead, Brook-street, and New Brighton.	1855	24,285	140	387	66 13 0
Birmingham, New-street, with Elementary Branches at Smethwick (Sponlane) and the Cape	1842	232,841	1,433	1,451	760 15 0
Bolton	1856	61,171	. .	. .	. .
Bristol (Academy of Arts)	1853	137,328	869	2,036	174 5 6
Carlisle	1854	26,310	454	524	69 15 0
Carnarvon	1853	8,674	664	692	81 18 6
Carmarthen	1854	10,524	206	159	63 0 0
Cheltenham	1853	35,051	1,392	1,544	287 13 6
Chester (Lecture Hall) Wrexham, Branch Sch.	1853	27,766	1,184	1,339	219 13 0
Clonmel (Mechanics' Instn.)	1854	17,720	232	251	112 12 0
Cork (Royal Institution)	1849	86,485	380	583	122 10 8
Coventry	1844	36,812	340	384	132 14 0
Dublin (Royal Dublin Soc.)	1849	147,506	293	389	227 14 7
Dudley (Dioc. Train. Sch.)	1853	37,962	841	752	124 16 0
Dundee	1856	78,931	. .	245	29 7 1
Dunfermline	1854	13,836	284	222	59 9 2
Durham, Saddler-street	1853	13,188	210	220	190 8 0
Exeter, High-street	1854	40,688	784	1,024	228 9 0
Glasgow	1845	329,097	976	773	529 9 0
Hampshire, N.W. district, including Andover, Basingstoke, & Whitchurch.	1854	. .	320	400 (about)	68 0 0
Hereford, with Branch at Ludlow.	1853	12,108	350	250	67 0 0
Leeds (Mechanics' Instn.)	1846	172,270	1,026	933	119 16 7
Lancaster	1856	34,660	. .	. .	. .
Limerick	1852	55,268	237	164	90 4 4
Liverpool:					
Central Authority	. .	375,955	. .	. .	. .
Branch Schools —					
North District School, (Collegiate Institution, Shaw-street).	1855	. .	1,362	1,102	209 11 4
South District School, (Mechanics' Institution, Mount-street).	1855	. .	648	560	320 13 9

Chairman.	Secretary.	Master or Masters.	Name of Place.
The Lord Provost .	Yeats, Alex. .	Cleland, Peter .	Aberdeen.
Tinling, Rev. E. D. .	Falconer, R. W., M.D.	Stannus, A. A. .	Bath.
Dufferin, Lord . .	Vance, Samuel .	Croome, J. D.; Hale, R.	Belfast (Phil. Instn.)
Dove, Percy M. .	Cole, Henry	Foster, William .	Birkenhead, Brook-street, and New Brighton.
Yorke, Hon. & Rev. G. M.	Unett, John W.	Wallis, G.; Wood, D.; Wallis, W.; Whitaker, C. H.; Walker, J. W.;	Birmingham, New-street, with Elementary Branches at Smethwick (Spon-lane) and the Cape.
. . .	. . .	. . .	Bolton.
Miles, P. W. S. .	Heyworth, Rev. J.	Ferrier, R. E. . .	Bristol (Academy of Arts).
The Mayor .	M'Alpine, Daniel	Brooke, A. N. . .	Carlisle.
Thomas, Rev. T. .	Wolseley, Robert.	Rowland, J. C. . .	Carnarvon.
Morris, W. . .	Barker, J. H. .	Davies, J. A. . .	Carmarthen.
Bellairs, Rev. H. W. .	Hugall, J. W. .	Knight, J. P. . .	Cheltenham.
Wardell, W. . .	Rigg, Rev. Arthur	Davidson, E. A. . .	Chester (Lecture Hall) Wrexham, Branch Sch.
Alderman Hackett .	Purcell, P. J. .	Healy, James . .	Clonmel (Mechanics' Instn.)
Fitzgibbon, W. (The Mayor)	Dunscombe, T. S.	Raimbach, D. W.; Sheil, E.	Cork (Royal Institution).
Leigh, Lord . .	Caldicott, R., Jun.	Rafter, H.; Hough, W.	Coventry.
Hone, Joseph, Jun. .	Steele, W. E., M.D.	Macmanus, H.; Holmes, T.	Dublin (Royal Dublin Soc.)
Browne, Rev. J. C., D.C.L. .	Blackwall, S. H. .	Cochrane, Robert .	Dudley (Dioc. Train. Sch.)
Anderson, Patrick .	Milne, George .	Kennedy, J. .	Dundee.
Birrel, George .	Kilgour, Alex. .	Cahill, R. S. .	Dunfermline.
Bramwell, J. .	Durham, Rev. T. C.	Newton, George .	Durham, Saddler-street.
Northcote, Sir S., Bt. .	Wescomb, C. .	Wigzell, M. . .	Exeter, High-street.
Alison, Sir A., Bart. .	Campbell, J. A. .	Wilson, C. H. . .	Glasgow.
Cubitt, W., M.P., and Portal, Wyndham	Best, Hon. & Rev. S.	Pyne, C. C. . .	Hampshire, N.W. district, including Andover, Basingstoke & Whitchurch.
Dean, Very Rev. The (Rich. Dawes, M.A.)	Fowler, J. T. O. .	Bustin, R. B. . .	Hereford, with Branch at Ludlow.
Wilson, T., and Beckett, W.	M'Ivor, Alexander	Swallow, J. C. . .	Leeds (Mechanics' Instn.)
The Mayor .	Whelon, W. .	Gilbert, H. . .	Lancaster.
Dunraven, Earl of .	Unthank, W. R. .	Clack, Thomas . .	Limerick.
. . .	. . .	. . .	Liverpool: Central Authority. Branch Schools— North District School, (Collegiate Institution, Shaw-street). South District School, (Mechanics' Institution Mount-street).
Howson, Rev. J. S. .	Horner, H. P. .	Bishop W. J.; Burkinshaw, S.	
Thornely, T., M.P. .	Cariss, Astrup .	Finnie, J.; Pugh, E.	

Appendix E.

Local Schools of Art.

Local Schoo

Name of Place.	Date of Establishment.	Population in 1851.	Total Number of Persons receiving Instruction in Drawing in the Year ending June 1855.	Total Number of Persons receiving Instruction in Drawing in the Year ending June 1856.	Total Sum received in Fees from Students.
					£. s. d.
Macclesfield (Mech. Instn.)	1850	33,048	469	477	82 1 8
Manchester (Royal Instn.)	1842	316,213	366	231	313 0 0
Newcastle-upon-Tyne, Collingwood-street.	1844	87,784	497	452	189 0 0
Norwich (Broad-street) .	1845	68,195	1,046	1,242	187 11 9
with Branch at Great Yarmouth .	1854	30,879	308	534	95 17 11
Nottingham, Stoney-street	1844	57,407	763	1,340	175 8 4
Oxford (Training School, Culham).	1854	27,843	. .	.	. .
Paisley . . .	1848	47,952	204	184	88 14 8
Penzance (Regent House)	1853	9,214	341	278	86 14 0
Petersfield . . .	1856	2,200	. .	. .	. .
Plymouth, Ebrington-street	1856	52,221	. .	297	135 3 9
Potteries, with Branches at Burslem (Mechanics' Institution),	1853	84,027	793	167	52 19 9
Hanley (British and Foreign School),	1847			122	43 18 10½
Newcastle-under-Lyme (Mechanics' Instn.),	1853			185	29 0 0
Stoke (Town Hall) .	1847			50	46 0 0
Sheffield . . .	1843	135,310	319	382	254 13 6
Southampton . .	1855	35,305	334	285	119 5 3
Stourbridge . .	1851	7,847	443	542	114 1 0
Swansea, with Branch at Llanelly (Nat. School.)	1853	31,461	616	460	67 9 6
Tavistock . . .	1854	8,086	341	337	95 10 6
Taunton . . .	1856	14,176	. .	71	9 12 4 for one mon
Truro . . .	1854	10,733	289	264	90 0 0
Warrington . .	1853	23,363	689	848	147 11 0
Waterford (Savings' Bank)	1852	29,288	165	290	167 4 7
Wenlock & Coalbrookdale .	1856	. .	. .	. .	. .
Wolverhampton . .	1853	119,748	252	250	185 0 0
Worcester . . .	1851	27,528	693	698	165 0 5
York, Minster-yard .	1843	40,359	335	237	100 7 0

F Art—*continued.*

Chairman.	Secretary	Master or Masters.	Name of Place.
Brocklehurst, W. C. (the Mayor)	Kelly, Thomas .	Stewart, George .	Macclesfield (Mech. Instn.)
Potter, Edmund .	Aspden, Richard .	Hammersley, J. A.; Evans, J.	Manchester (Royal Instn.)
Watson, Joseph .	Leathart, James .	Scott, W.B.; Harrison, W.	Newcastle-upon-Tyne, Collingwood-street.
Bignold, Sir S., M.P.	Nursey, C. L. .	Nursey, C.L.; Elton, S.	Norwich, (Broad-street,) with Branch at Great Yarmouth.
Palmer, C. J., (the Mayor)	Bampton, Rev. J.P.	Griffiths, W. T. .	
Heymann, Lewis .	Richards, William	Fussell, F. R. . .	Nottingham, Stoney-street.
. . . .	. . . .	. . . .	Oxford (Training School, Culham).
Murray, David .	Martin and Hodge, Messrs.	Stewart, W.; Urie D.	Paisley.
Coulson, T. (the Mayor).	Rodd, W. H. .	Geoffroi, H. . .	Penzance (Regent House).
. . . .	. . . .	. . . .	Petersfield.
Eastlake, W. .	Iago, George .	Offord, J. J. . .	Plymouth, Ebrington-street.
Pinder, Thomas .	Mayer, J. . .	Mückley, W. J. . .	Potteries, with Branches at Burslem (Mechanics' Institution), Hanley (British and Foreign School), Newcastle-under-Lyme (Mechanics' Instn.), Stoke (Town Hall).
Wedgwood, F. .	Shirley, John .	Hodgetts, T. . .	
Broad, Rev. J. S. .	Earl, Emanuel .	Ryles, G. . . .	
Wedgwood, F. .	Baynes, Charles .	Rice, S., Protat, Hugues.	
Branson, Ferguson, M.D.	Wightman, Benjamin.	Mitchell, Y.; Peppercorn, J. P.; Lomas, H. D.	Sheffield.
Andrews, R. (the Mayor)	Critchlow, R. .	Baker, W. J. . .	Southampton.
Foley, J. H. H., M.P.	Price, Rowland .	Yeats, G. P. . .	Stourbridge.
Hoggridge, Mathew .	Smart, J. N. .	Hamerton, R. J. .	Swansea, with Branch at Llanelly (Nat. School).
Benson, John . .	Greenfield. T. W.	Tucker, Raymond .	Tavistock.
Elliot, W. F. . .	Jones, Rev. W. A.	Williamson, J. B. .	Taunton.
weedy, W. M. .	Brewer, John .	Gill, G. R. . .	Truro.
atten, J. W., M. P. .	Brewtnall, Edward	Thompson, T. C. .	Warrington.
he Very Rev. the Dean	Gibson, George .	M'Cloy, S. . . .	Waterford (Savings' Bank).
. . .	. . .	. . .	Wenlock & Coalbrookdale.
artley, John . .	Mander, C. B. .	Chittenden, T. . .	Wolverhampton.
Yard, Rt. Hon. Lord	Aldrich, Henry .	Kyd, J. Bowen, W. P.	Worcester.
pencer, Rev. Isaac .	Atkinson, J. B. . Dykes, W. H.	Swallow, J. C. . .	York, Minster-yard.

Appendix E.

LOCAL SCHOOLS OF ART.

LOCAL SCHOOLS of ART in Actio

Elementary Instruction.

Name of Place.	Public Schools of the class of those under the inspection of Privy Council.				Priva receiving instruct	
	No. of Schools taught.	No. of Lessons per week.	Amount of Payment per annum.	No. of Scholars.	No. of Schools taught.	No. o Lesson per wee
			£ s. d.			
Aberdeen	1	1	5 0 0	200	3	7
Bath	4	4	15 0 0	402	3	5
Belfast	.	.	. . .	.	.	.
Birkenhead	3	3	15 0 0	226	1	1
Birmingham	13	14	130 0 0	683	.	.
Bolton	.	.	. . .	.	.	.
Bristol	7	7	55 0 0	896	2	5
Carlisle	3	3	15 0 0	145	4	8
Carnarvon	5	6	40 0 0	656	1	1
Carmarthen	3	4	20 0 0	98	.	.
Cheltenham	7	8	85 0 0	1,233	2	3
Chester	8	10	97 10 0	946	5	6
Clonmel	1	5	50 0 0	164	.	.
Cork	4	4	50 0 0	430	.	.
Coventry	.	.	. . .	.	.	.
Dublin	.	.	. . .	.	.	.
Dudley	10	10	63 15 0	643	.	.
Dundee	2	2	10 0 0	95	.	.
Dunfermline	3	3	15 0 0	142	.	.
Durham	3	4	20 0 0	80	1	2
Exeter	7	9	60 0 0	625	.	.
Glasgow	2	10	80 0 0	205	.	.
Hampshire, N. W. Dist.	6	6	30 0 0	383	3	3
Hereford	2	2	10 0 0	75	3	4
Branch at Ludlow	.	.	. . .	.	2	2
Lancaster	.	.	. . .	.	.	.
Leeds	4	5	25 0 0	625	2	7
Limerick	1	1	5 0 0	15	1	2
Liverpool:						
North District School	13	13	65 0 0	802	.	.
South District School	4	4	20 0 0	263	.	.
Macclesfield	4	4	20 0 0	307	.	.
Manchester	10	10	50 0 0	737	.	.
Newcastle-on-Tyne	3	3	15 0 0	170	.	.
Norwich	10	12	25 0 0	1,047	.	.
Branch at Yarmouth	3	3	15 0 0	300	3	3
Nottingham	4	4	26 0 0	210	.	.
Oxford (Culham Tr. Sch.)	.	.	. . .	.	.	.
Paisley	1	3	5 16 2 & expenses.	18	.	.
Penzance	2	4	20 0 0	135	5	9
Petersfield	.	.	. . .	.	.	.
Plymouth	3	2	5 0 0	80	.	.
Potteries:—						
Burslem	3	8	10 0 0	72	1	2
Hanley	2	2	10 0 0	27	.	.
Newcastle-under-Lyme	3	4	20 0 0	135	.	.
Stoke	.	.	. . .	.	.	.
Sheffield	.	.	. . .	.	1	2
Southampton	5	4	25 0 0	116	1	1
Stourbridge	6	7	50 0 0	401	2	2
Swansea	3	4	15 0 0	349	1	1
Tavistock	3	3	15 0 0	229	3	3
Taunton	1	1	5 0 0	25	.	.
Truro	2	2	10 0 0	106	2	2
Warrington	4	5	55 0 0	677	2	2
Waterford	3	12	60 0 0	193	.	.
Wenlock	.	.	. . .	.	.	.
Wolverhampton	3	3	15 0 0	72	.	.
Worcester	4	4	20 0 0	405	.	.
York	2	1	5 0 0	40	.	.

…ring the Year ending June 30, 1856.

…hools …m the Teacher.		Schools where the Schoolmasters and Schoolmistresses themselves give Instruction in Drawing.		No. of Schoolmasters, Schoolmistresses, and Pupil-teachers who have attended the School.	Local Expenditure on account of Examples during the Year.	Name of Place.
…mount of …ayment per …nnum.	No. of Scholars.	No. of Schools.	No. of Scholars.			
£ s. d.					£ s. d.	
5 0 0	195	. .	. .	48	2 5 7	Aberdeen.
0 0 0	94	4	120	35	. . .	Bath.
. .	.	. .	. .	. .	12 8 4	Belfast.
6 0 0	34	. .	. .	12	. . .	Birkenhead.
. .	.	. .	. .	27	. . .	Birmingham.
. .	.	. .	. .	. .	. . .	Bolton.
0 0 0	238	4	602	60	. . .	Bristol.
8 0 0	190	1	50	39	. . .	Carlisle.
7 10 0	8	. .	. .	16	13 15 0	Carnarvon.
. .	.	. .	. .	9	. . .	Carmarthen.
0 0 0	68	. .	. .	47	7 14 5	Cheltenham.
0 0 0	170	. .	. .	12	5 0 6	Chester.
. .	.	. .	. .	. .	2 0 0	Clonmel.
. .	.	. .	. .	4	16 16 9	Cork.
. .	.	. .	. .	11	20 0 8	Coventry.
. .	.	. .	. .	. .	13 10 4	Dublin.
. .	.	. .	. .	1	. . .	Dudley.
. .	.	. .	. .	9	52 12 0	Dundee.
. .	.	. .	. .	8	. . .	Dunfermline.
8 0 0	20	2	. .	6	4 2 0	Durham.
. .	.	1	210	46	. . .	Exeter.
. .	.	. .	. .	72	7 0 0	Glasgow.
0 0 0	.	2	. .	. .	. .	Hampshire, N.W. District.
0 0 0	135	. .	. .	11	. . .	Hereford.
7 10 0	47	. .	. .	. .	. .	Branch at Ludlow.
. .	.	. .	. .	. .	. . .	Lancaster.
1 5 0	170	. .	. .	1	. .	Leeds.
1 0 0	7	. .	. .	. .	5 7 4	Limerick.
. .	.	. .	. .	289	. . .	Liverpool:
. .	.	. .	. .	. .	15 0 0	North District School.
. .	.	. .	. .	19	1 10 8	South District School.
. .	.	. .	. .	100	. . .	Macclesfield.
. .	.	. .	. .	21	1 4 0	Manchester.
. .	.	. .	. .	24	. . .	Newcastle-on-Tyne.
0 0 0	44	1	100	27	4 16 10	Norwich, Branch at Yarmouth.
. .	.	6	755	21	. . .	Nottingham,
. .	.	. .	. .	. .	. . .	Oxford (Culham Tr. Sch.)
. .	.	. .	. .	5	1 8 4	Paisley.
8 18 0	40	. .	. .	9	. . .	Penzance.
. .	.	. .	. .	. .	. . .	Petersfield.
. .	.	. .	. .	21	48 2	Plymouth.
5 0 0	14	. .	. .	16	25 0 0	Potteries:—
. .	.	. .	. .	4	. . .	Burslem.
. .	.	1	12	4	2 0 0	Hanley.
. .	.	. .	. .	. .	. . .	Newcastle-under-Lyme.
0 0 0	18	. .	. .	25	18 2 2	Stoke.
0 10 0	10	2	. .	11	2 9 2	Sheffield.
2 15 0	8	1	16	4	1 13 8	Southampton.
2 10 0	25	.	. .	15	. . .	Stourbridge.
7 12 0	35	.	. .	11	. . .	Swansea.
. .	.	2	. .	9	. . .	Tavistock.
0 0 0	28	. .	. .	6	. . .	Taunton.
5 0 0	54	3	. .	33	19 0 0	Truro.
. .	.	. .	. .	3	. . .	Warrington.
. .	.	. .	. .	. .	. . .	Waterford.
. .	.	. .	. .	17	3 12 6	Wenlock.
. .	.	. .	. .	33	32 4 6	Wolverhampton.
. .	.	. .	. .	30	. . .	Worcester.
						York.

Appendix E.

LOCAL SCHOOLS OF ART.

LOCA

Name of Place.	Day Classes.						Evenin		
	Males.			Females.			Males.		
	No. of lessons per week.	Average No. attending.	Rate of Fees.	No. of lessons per week.	Average No. attending.	Rate of Fees.	No. of lessons per week.	Average No. attending.	Rate of Fee
Aberdeen	3	48	15*s.* per quarter.	3	20	15*s.* per quarter.	4	31	2*s.* 6*d.* per month.
Bath	4	50	10*s.* and 8*s.* per quarter.	2	30	1*l.* 1*s.* per quarter.	3	40	2*s.* per mon
Belfast	5	34	1*l.*, 10*s.*, 7*s.*6*d.*, and 5*s.*, per term.	6	12	1*l.*, 10*s.*, 7*s.* 6*d.*, and 5*s.* per term.	5	70	1*l.*, 10*s.*, 7*s.* 6 and 5*s*, pe term.
Birkenhead				2	9	6*s.* per month	5	14	2*s.* per mon
Birmingham	3	132	11*s.* 6*d.*, and 15*s.* per session.	4	35	7*s.* 6*d.*, 10*s.*, 1*l.* 2*s.* 6*d.*, and 1*l.* 10*s.* per session.	5	89	7*s.* 6*d.* and 1 per sessio
Bolton									
Bristol	4	13	4*s.* per month	2	4	2*s.* and 1*s.* per month.	6	56	7*s.* per mon
Carlisle				3	19	4*s.* per month	5	41	2*s.* per mon
Carnarvon							3	18	10*s.* per quarter an 2*s.* per mon
Carmarthen	3	6	4*s.* per month	3	7	4*s.* per month	3	20	2*s.* per mon
Cheltenham	5	.	10*s.* per quarter.	5	.	10*s.* per quarter.	4	.	5*s.* per quarter.
Chester				2	7	4*s.* per month	4	37	2*s.* per mon
Clonmel				3	4	1*l.* 1*s.* per term.	6	20	10*s.* and 5 per term
Cork	3	18	10*s.* per term	3	20	10*s.* per term	3	112	10*s.* per te
Coventry	7	130	10*s.* per session.	2	20	10*s.* per session.	5	45	10*s.* per session.
Dublin	17	.	2*s.*, 3*s.*, 4*s.*, 5*s.*, and 7*s.* 6*d.* per month.	17	.	2*s.*, 3*s.*, 4*s.*, 5*s.*, and 7*s.* 6*d.* per month.	7	.	1*s.*, 1*s.* 6 and 2*s.* pe month.
Dudley				4	.	1*l.* 1*s.* & 10*s.* 6*d.* per quarter.	6	.	2*s.* per mo
Dundee	5	40	10*s.* 10*d.* per quarter.	5	25	10*s.* 10*d.* per quarter.	8	60	10*s.* per quarter, a 2*s.* per mo
Dunfermaline				3	14	12*s.* per quarter.	3	28	6*s.* per quarter
Durham				2	20	8*s.* per month	3	30	2*s.* per mo
Exeter	2	5	1*l.* 1*s.* per quarter.	2	18	1*l.* 1*s.* per quarter.	5	74	1*s.* and 2 per mon
Glasgow	8	104	5*s.*, 3*s.*, and 2*s.* per month.	9	57	7*s.*, 5*s.*, and 4*s.* per month.	9	156	3*s.*, 2*s.*, an per mon
Hampshire, North Western District.	.	.	2*l.* 10*s.*, 1*l.* 5*s.*, and 10*s.* per quarter.	.	.	2*l.* 10*s.*, 1*l.* 5*s.*, and 10*s.* per quarter.	.	.	
Hereford	1	5	12*s.* 6*d.* per quarter,	.	.		3	10	2*s.* per mo
Leeds	4	8	10*s.* 6*d.* and 5*s.* per quarter	2	6	10*s.* 6*d.* per quarter.	5	43	6*s*, and 3*s* per quar
Lancaster	1	.	7*s.* 6*d.* per session.	5	.	2*l.*, 1*l.*, and 7*s.* 6*d.* per session.	5	.	7*s.* 6*d.* an per sess
Limerick	6	7	10*s.* and 5*s.* per month.	6	19	10*s.* and 5*s.* per month.	5	33	2*s.* per mo
Liverpool :— N. District Sch.	.	.		2	7	1*l.* per quarter.	6	65	6*s.* 6*d.* & 1 per quar
S. District Sch.	4	250	no fee	4	30	1*l.* per quarter.	4	110	6*s.* 6*d.* quarte

Schools.										Studentships.			
Classes.			No. of individual students who have attended the school at any time.			Average rate of Fees paid by each student.	Average No. of students attending monthly during the year.	Pupil Teacherships.		No. of free students whose fees are paid by the Department.	No. of students entering Central training class.	No. of students who hold scholarships in Central School.	Name of Place.
Females.								No. on whose behalf the Department pays half the fees, c. 110.	No. appointed under c. 98.				
No. of lessons per week.	Average No. attending.	Rate of Fees.	Male.	Female.	Total.								
3	31	2*s.* 6*d.* per month.	181	80	261	3*s.* monthly.	130	6	2	2	.	.	Aberdeen.
.	.	. . .	133	103	236	9*s.* per quarter.	105	3	2	1	.	.	Bath.
5	26	1*l.*, 10*s.*, 7*s.* 6*d.* and 5*s.* per term.	104	38	142	2*s.* monthly.	78	.	2	.	.	.	Belfast.
5	14	2*s.* per month	92	35	127	. .	37	3	.	.	.	.	Birkenhead.
.	.	. . .	639	129	768	13*s.* per session.	429	.	.	.	.	.	Birmingham.
.	.	. . .	.	.	.	. .	.	.	.	.	.	.	Bolton.
6	26	1*s.*, 2*s.*, and 4*s.* per month.	166	134	300	10*s.* 7½*d.* per an.	114	46	1	.	.	.	Bristol.
2	19	2*s.* per month	102	37	139	3*s.* per month.	61	27	1	1	.	.	Carlisle.
3	3	10*s.* per quarter.	25	3	28	. .	19	10	.	1	.	.	Carnarvon.
3	10	2*s.* per month	38	23	61	3*s.* per month.	45	6	1	.	.	.	Carmarthen.
4	.	5*s.* per quarter.	87	153	240	7*s.* 6*d.* per quarter.	120	26	1	.	.	.	Cheltenham.
1	.	3*s.* per month	85	22	107	2*s.* per month.	62	3	2	1	.	.	Chester.
2	18	5*s.* per term.	33	37	70	18*s.* 10½*d.* per term.	36	.	2	1	.	.	Clonmel.
3	20	10*s.* per term	107	46	153	. .	.	.	2	2	.	.	Cork.
3	3	1*l.* per session	342	37	379	7*s.* per month.	260	.	2	1	.	.	Coventry.
.	.	. . .	235	154	389	2*s.* 3*d.* per month.	206	.	.	.	1	.	Dublin.
.	.	. . .	79	30	109	8*s.* 3*d.* per quarter.	25	1	2	1	.	.	Dudley
.	.	. . .	130	20	150	1*l.* 12*s.* per annum.	116	.	.	.	.	.	Dundee.
3	6	4*s.* 6*d.* per quarter.	48	32	80	11*s.* 1*d.* per quarter.	42	6	1	1	.	.	Dunfermline.
2	8	4*s.* per month	66	54	120	4*s.* 8*d.* per month.	58	2	2	1	.	.	Durham.
4	31	1*s.* and 2*s.* per month.	128	61	189	18*s.* per quarter.	98	37	1	1	.	.	Exeter.
3	16	2*s.* and 1*s.* per month.	673	100	773	2*s.* 6*d.* per month.	360	.	4	.	.	.	Glasgow.
.	.	. . .	.	.	.	. .	.	.	.	.	.	.	Hampshire, N.W. District.
3	15	2*s.* per month	45	12	57	1*s.* 5*d.* per month.	35	.	2	1	.	.	Hereford.
.	.	. . .	125	13	138	6*s.* 8*d.* per month.	22	.	.	.	.	.	Leeds.
.	.	. . .	.	.	.	17*s.* 3*d.* per session.	.	.	.	.	.	.	Lancaster.
5	15	2*s.* per month	82	60	142	3*s.* 6*d.* per month,	87	.	.	.	.	.	Limerick.
7	110	6*s.* 6*d.* & 1*s.* 9*d.* per quarter.	96	204	300	5*s.* per quarter.	182	.	1	.	.	.	Liverpool:— N. Dis. Sch.
.	.	. . .	239	58	297	13*s.* 3*d.* per quarter.	390	.	2	.	1	.	S. Dis. Sch.

Appendix E.

LOCAL SCHOOLS OF ART.

LOCAL

Name of Place.	Day Classes.						Evening		
	Males.			Females.			Males.		
	No. of lessons per week.	Average No. attending.	Rate of Fees.	No. of lessons per week.	Average No. attending.	Rate of Fees.	No. of lessons per week.	Average No. attending.	Rate of Fees
Macclesfield	5	5	3*s.* 6*d.* per month.	5	9	2*s.* 6*d.* per month.	5	78	1*s.* 6*d.* per month, and 1*s.* 6*d.* per quarter.
Manchester	10	80	9*s.*, 10*s.* 6*d.*, 1*l.* 1*s.*, & 2*l.* 2*s.* per quarter.	10	80	9*s.*, 10*s.* 6*d.*, 1*l.* 1*s.*, & 2*l.* 2*s.* per quarter.	10	300	3*s.*, 6*s.*, & 9*s.* per quarter.
Newcastle-on-Tyne	3	4	5*s.* per month	3	18	7*s.* and 5*s.* per month.	5	111	2*s.* 6*d.* per month.
Norwich	2	4	1*l.* per quarter.	2	5	1*l.* per quarter.	6	25	3*s.* 6*d.* and 2*s* per month.
Yarmouth (Branch School).	2	7	10*s.* per quarter.	4	14	15*s.* and 10*s.* per quarter.	3	22	2*s.* per month
Nottingham	6	7	1*l.* and 1*l.* 5*s.* per session.	4	21	1*l.* 10*s.* and 1*l.* per session.	10	74	9*s.* per session.
Oxford	.	.	.	.	.	.	.	.	.
Paisley	5	6	4*s.* and 2*s.* per month.	5	15	4*s.* and 2*s.* per month.	11	68	3*s.* 6*d.*, 2*s.* 6*d.*, 2*s.* per quarte
Penzance	2	7	4*s.* per month	2	7	4*s.* per month	5	52	2*s.* per month
Petersfield	.	.	.	.	.	.	.	.	.
Plymouth	2	6	8*s.* per month	4	20	8*s.* and 4*s.* per month.	8	96	4*s.*, 2*s.*, and 1 per month
Potteries:—									
Burslem	2	5	10*s.* 6*d.* per quarter.	2	5	10*s.* 6*d.* per quarter.	5	18	2*s.* per month
Hanley	2	.	1*s.* 9*d.* per month.	2	12	1*s.* per month	3	20	1*s.* 9*d.* per month.
Newcastle-under-Lyme.	.	.	.	.	.	.	5	16	1*s.* 9*d.* per month.
Stoke	3	3	4*s.* per month	3	5	4*s.* per month	13	30	2*s.*, 2*s.* 6*d.*, 4 and 4*s.* 6*d.* per month
Sheffield	2	10	10*s.* 6*d.* per quarter.	3	37	1*l.* 1*s.* & 10*s.* 6*d.* per quarter.	5	80	5*s.* per quarter.
Southampton	5	8	8*s.*, 4*s.*, & 1*s.* 3*d.* per month.	5	8	8*s.*, 4*s.*, & 1*s.* 3*d.* per month.	6	31	2*s.* and 1*s.* 3 per month
Stourbridge	.	.	.	2	9	10*s.* 6*d.* per quarter.		58	6*s.* per quarter.
Swansea	2	no attendance.	4*s.* per month	2	10	4*s.* per month	3	30	2*s.* per month
Taunton	2	4	1*l.* 1*s.* per quarter.	2	2	1*l.* 1*s.* per quarter.	5	38	3*s.* 4*d.* and 2 per month
Tavistock	1	8	4*s.* per month	2	16	4*s.* per month	3	14	2*s.* per mon
Truro	.	.	.	2	30	4*s.* per month	2	30	2*s.* per mon
Warrington	4	17	2*s.*, 3*s.* 6*d.*, & 7*s.* per month.	4	19	2*s.*, 3*s.* 6*d.* & 7*s.* per month.	2	30	2*s.* per mon
Waterford	.	.	.	4	34	10*s.* 6*d.* per session.	3	13	2*s.* per mon
Wenlock	.	.	.	.	.	.	.	.	.
Wolverhampton	2	9	1*l.* 1*s.* and 15*s.* per quarter.	4	28	1*l.* 1*s.*, 15*s.*, and 5*s.* per quarter.	2	81	5*s.* per quarter.
Worcester	7	24	1*l.* 1*s.*, 12*s.*, 5*s.*, 6*d.*, and 4*s.* per quarter.	5	41	1*l.* 1*s.*, 12*s.*, and 4*s.* per quarter.	5	98	5*s.* 6*d.* and 4*s.* per quarter.
York	4	.	10*s.* and 3*s.* per month.	6	.	10*s.*, 3*s.*, & 2*s.* per month.	4	. .	2*s.* per mon

Schools.									Pupil Teacherships.		Studentships.			Name of Place.
Classes.			No. of individual students who have attended the school at any time.			Average rate of fees paid by each student.	Average No. of students attending monthly during the year.							
Females.														
No. of lessons per week.	Average No. attending.	Rate of Fees.	Male.	Female.	Total.				No. on whose behalf the Department pays half the fees, c. 110.	No. appointed under c. 98.	No. of free students whose fees are paid by the Department.	No. of students entering Central training class.	No. of students who hold scholarships in Central School.	
5	28	1*s.* per month and 1*s.* 6*d.* per quarter.	130	40	170	8*s.* 8*d.* per quarter.	120		19	3	3	1	.	Macclesfield.
13	320	3*s.*, 6*s.*, 9*s.*, and 10*s.* 6*d.* per quarter.	570	210	780	12*s.* 8*d.* per quarter.	200		.	4	1	.	.	Manchester.
.	.	. . .	230	52	282	16*s.* 8*d.* per year.	133		.	2	1	.	.	Newcastle-on-Tyne.
6	24	3*s.* 6*d.* and 2*s.* per month.	151	44	195	16*s.* 8*d.* per year.	134		24	2	1	.	.	Norwich.
2	18	2*s.* per month	33	57	90	1*l.* 7*s.* 4*d.* per year.	126		6	1	.	.	.	Yarmouth. (Branch Sch.)
3	12	9*s.* per session	255	70	325	2*s.* 5*d.* per month.	62		.	1	.	.	.	Nottingham.
.	.	. . .	.	.	.	.	.		.	.	.	.	.	Oxford.
3	7	2*s.* 6*d.* per quarter.	138	28	166	3*s.* per month.	96		.	2	1	.	.	Paisley.
.	.	. . .	68	35	103	12*s.* 11½*d.* per year.	60		8	1	1	.	.	Penzance.
.	.	. . .	.	.	.	.	.		.	.	.	.	.	Petersfield.
3	6	1*s.* per month	176	41	217	3*s.* 5*d.* per month.	122		.	.	.	.	.	Plymouth.
														Potteries:—
5	17	2*s.* per month	66	15	81	18*s.* 9*d.* per year.	50		1	2	1	.	.	Burslem.
3	4	1*s.* per month	65	30	95	1*s.* 5*d.* per month.	40		1	.	.	.	.	Hanley.
5	4	1*s.* 6*d.* per month.	34	4	38	7*s.* 4*d.* per session.	20		.	1	1	.	.	Newcastle-under-Lyme.
13	29	2*s.*, 2*s.* 6*d.*, 4*s.*, and 4*s.* 6*d.* per month.	45	5	50	18*s.* 5*d.* per year.	37		.	2	1	1	.	Stoke.
.	.	. . .	314	50	364	12*s.* 10½*d.* per year.	127		21	1	2	1	.	Sheffield.
.	.	. . .	132	27	159	12*s.* 3*d.* per year.	49		.	.	.	.	.	Southampton.
2	3	6*s.* per quarter.	91	26	117	7*s.* 1½*d.* per session.	62		2	.	.	.	.	Stourbridge.
.	.	. . .	76	10	86	3*s.* per month.	38		.	.	.	.	.	Swansea.
2	2	1*s.* per month	42	4	46	4*s.* per month.	46		.	.	.	.	.	Taunton.
2	3	2*s.* per month	46	27	73	3*s.* 1½*d.* per month.	47		3	1	1	.	.	Tavistock.
2	10	2*s.* per month	70	60	130	3*s.* per month.	60		11	1	1	.	.	Truro.
.	.	. . .	82	35	117	4*s.* 2*d.* per month.	66		30	2	1	1	.	Warrington.
3	12	2*s.* per month	35	62	97	. .	20		.	2	.	.	.	Waterford.
.	.	. . .	.	.	.	.	.		.	.	.	.	.	Wenlock.
.	.	. . .	129	49	178	13*s.* 8*d.* per quarter.	116		15	.	.	.	.	Wolverhampton.
5	34	4*s.* per quarter.	203	90	293	15*s.* 7¾*d.* per annum.	170		4	.	2	.	.	Worcester.
.	.	. . .	96	101	197	. .	96		.	2	1	.	.	York.

Appendix E. Local Examinations of Students' Works.

NOMINAL RETURN of STUDENTS to whom MEDALS were awarded at the LOCAL EXAMINATIONS held by the INSPECTORS of the DEPARTMENT in 1856.

Names of Students.	Stages.
SCHOOLS OF ART:	
ABERDEEN.	
John Menzies	22 c.
Evander McIvor	23 b.
James Donald	23 a.
Robert Ewen	22 c.
John Henry Johnston	22 c.
BATH.	
Job Allen	4 b.
Edward Tuck	10 a.
Fanny Jolly	8 d.
Thomas Hilliar	11 b.
BELFAST.	
David Clarke	2 b.
Wm. Erskine	6 a.
Wm. George Russell	2 b.
BIRKENHEAD.	
E. F. Smith	2 b.
E. J. Grayson	4 b.
Frances Toby	3 b.
Philip Phillips	7 a.
BIRMINGHAM.	
Not examined this year.	
BOLTON.	
New school.	
BRISTOL.	
Ellen M. Simpson	2 b. 22 c.
Thomas H. Thomas	22 c. 22 d.
CARLISLE.	
Edward Taylor Morley	23 a.
Robert Little	3 b.
Henry Manson	22 a.
Elizabeth Carr	13 a.
CARMARTHEN.	
No Local Medals were awarded.	

Names of Students.	Stages.
SCHOOLS OF ART:	
CARNARVON.	
Richard Griffiths	6 a.
Thomas H. Jones	3 b.
Griffith Williams	2 b.
CHELTENHAM.	
Thomas Darby	10 a.
William Balcombe	11 b.
Thomas Waite	14 a. 22 a.
Lucy Hanson	13 a.
Bessy Hill	10 a.
Eliza Brewer	10 b. 23 f.
James Boulter	14 a.
Eliza Leite Herring	13 b.
CHESTER.	
Joseph McEvoy	2 b.
Charles Winslow	11 b.
James Webster	6 a.
CLONMEL.	
Thomas B. Jacob	2 b.
Mary Hodgson	4 b.
CORK.	
Thomas Petty	3 b.
Alice Wright	7 a.
John S. Morgan	9 a. 17 b. 23 c.
Anne Olden	13.
Wm. Patterson	22 d.
Jane Morgan	23 c.
John Morrough	6 a.
Henry O'Shea	8 a.
Jane White	12 a. 14 a.
Elizabeth Max	15.
Augustine O'Leary	22 d.
COVENTRY.	
William Owen	2 b. 23 c.
Francis Grimes	8 b.
Eleanor Cash	14 a. 23 c.
William Howard Reeves	22 b.
William Andrews	8 a. 9 a.
John Wells Smith	11 b.
Samuel Owen	16 a. 23 c.
Thomas Mallinson	3 b. 10 a. 12 a. 22 a. 22 c. 22 d. 23 b.

Names of Students.	Stages.
SCHOOLS OF ART:	
DUBLIN LACE SCHOOL.	
Mary Godwin	2 b. 23 c.
Ellen Bullen	2 b. 3 b. 10 a.
Mary Jane Bullock	3 b.
Mina Otway	10 a.
Mary Jane Nicholl	23 c.
Anne Lavin	23 c.
Catherine Duggan	2 b.
Catherine Ludden	3 b.
Jane Phillips	10 a.
Rebecca Nicholl	2 b.
Eliza Ross	4 b.
DUBLIN SCHOOL OF ART.	
Margaret White	14 a.
Francis Hare	23 c.
Rosalie Ayre	4 b.
Anna Wright	14 a.
James Brown	18 a.
Elizabeth S. White	23 c.
Arthur Mayne	3 b. 5 b.
Thomas Whelan	4 b.
Selina Bushe	5 b.
Kate Seymour	17 a. 14 b.
John Clarke	19 a.
John Woodhouse	19 a.
DUDLEY.	
Catherine Fellows	15 a.
Mary Cowpland	10 a. 3 b.
Caroline Smith	10 a.
Benjamin Webb	3 b.
DUNFERMLINE.	
John McKean Brydon	23 a.
DUNDEE.	
Ellen Cox	2 b.
Andrew Stevenson	4 b. 6 a.
Robert Grant	23 a.
Andrew Robertson	2 b.
Joseph Kennedy	5 b. 13 a.
Sylvester Rait Wybrants	23 a.
DURHAM.	
John Rennison	2 b.
Joseph Henderson Bentham	5 b.
Micah Chambers	23 c. 13 a.
Elizabeth Hays	15.
Isabella Hays	22 c.
Anne Margaret Waugh	23 c.
Jane Hays	23 c.

Names of Students.	Stages.
SCHOOLS OF ART:	
EXETER.	
Rich. F. Banfill	3 b.
Leonora F. Bingham	12 a.
Alfred T. Morrish	11 b.
Eliza Wigzell	4 b.
Catherine F. Kennaway	12 a.
Annis Kingdon	14 a.
GLASGOW.	
John Finlay	23 a.
William M'Connel	2 a.
John Allan	3 b.
James Greenlees	6 a.
John Duncan Donaldson	7 a.
James M'Dowell	14 a. 23 c.
George Millar	18 a.
Alexander M'Callum	19 c.
Margaret Harvey Kelly	22 a.
James Rogerson	23 c.
Paul Bellitzay	23 c.
William Harley	23 a.
Robert Samuel Connel	2 a.
William Gray	4 b.
Francis Leslie	8 a.
Archibald Smeaton	10 b.
Margaret Walker Smith	17 a.
James Barclay	19 a.
Thomas Fitzgerald	22 b.
James Gay	22 d.
Peter M'Gregor	23 c.
John Campbell	23 c.
HAMPSHIRE.	
(North-west District Schools.)	
Not examined this year.	
HEREFORD.	
Frederick Lane	2 b.
George Caldwell	3 b. 5 b. 6 a.
Sophia Jones	7 a.
William Caldwell	2 b.
Margaret Price	7 a.
LEEDS.	
Samuel Lawson Booth	6 a.
E. Basset Keeling	23 b.
Thomas Whitham	17 a.
LANCASTER.	
Not examined this year.	

Appendix E.

LOCAL EXAMINATIONS OF STUDENTS' WORKS.

Names of Students.	Stages.
SCHOOLS OF ART:	
LIMERICK.	
Caroline Fitzgerald	12 a.
Augustus W. Howard	17 a.
Mary Seymour	2 b.
Sarah Richardson	13 a.
Benjamin M. Brew	8 a. 2 b. 3 b.
(LIVERPOOL, North District.)	
Henry Jas. Charlton	15.
William Parslow	23 b.
John Hulse	23 b.
(LIVERPOOL, South District.)	
Jas. Birkmyer	3 b. 4 b. 5 b. and 6 a.
F. Boult	4 b.
Edward Wade	5 b.
Alexr. Banner	2 b. 4 b.
Jas. Draper	6 a.
G. A. Wartnaby	22 d.
MACCLESFIELD.	
Not examined this year.	
MANCHESTER.	
Adolphus Martin	2 b.
George Roberts	3 b. 9 a.
Caroline S. Woods	4 b.
Thos. C. M. Macdonnell	5 b.
Davis Benson	6 a.
Daniel Adamson	8 b.
James S. Edmondson	10 a.
George Brown	12 a.
Sarah A. Sands	13 a.
James Fish	14 a. 22 c.
Daniel Dixon	22 c.
H. Wm. Hargreaves	2 b.
George H. Smith	3 b. 22 d.
Robert Thorp	4 b. 14 a.
Walter Petty	6 a.
Joseph Platt	7 a.
Adam West	10 a.
Charles Slater	10 b.
Edw. Evans	12 a. 17 b.
Mary Ganthorpe	15. 14 a.
Wm. M. Platt	15. 22 a. 23 c.
Francis Strahan	18 a.
METROPOLITAN DISTRICT SCHOOLS.	
Not examined this year.	

Names of Students.	Stages.
SCHOOLS OF ART:	
NEWCASTLE-UPON-TYNE—	
Peter Robert Perry	4 b.
Bartholomew Bowlt	8 b.
Fanny Proctor	16 a. 22 a.
Helen Proctor	22 c.
George Gibb	22 d.
John Alexander Bryson	23 b.
Archibald Spence	5 b.
Rebecca Dickenson	9 a. 22 c.
Frederick William Rich	16 a.
John Inglis	22 c.
Henry Spencer	23 a.
NORWICH.	
R. Lloyd	2 b.
James Smith	4 b.
George Searles	6 a.
Zeph. King	22.
James Minns	2 b.
James Reeve	5 b.
R. N. Havers	9 & 15 a.
Samuel Harcourt	23.
YARMOUTH.	
Samuel Swann	4.
NOTTINGHAM.	
Not examined this year.	
OXFORD.	
No competition for Medals.	
PAISLEY.	
James Reid	3 b. 2 b.
John Blair	16 a. 8 b.
James M'Farlane	22 c. 23 c.
William Wilson	23 a.
Wm. M'Donald	8 a. 8 b. 9 a.
Robert Urie	22 c. 23 c.
Charles Hays	23 c. 22 d.
Samuel Hodgert	23 a.
PENZANCE.	
Richard Pentreath	7 b.
James Ford	8 b. 11 b. 13 a. & 22 c.
John Atkinson	23 d.
Fortescue Millett	8 a. 15.
Mary Jane Woodcock	12 a.
John Murphy	23 a.

Names of Students.	Stages.
SCHOOLS OF ART:	
PETERSFIELD.	
New school.	
PLYMOUTH.	
Jane Marshall	2 a.
Edwin Chandler	4 b.
POTTERIES.	
BURSLEM.	
Not examined this year.	
HANLEY.	
Not examined this year.	
NEWCASTLE-UNDER-LYME.	
Not examined this year.	
STOKE-UPON-TRENT.	
Not examined this year.	
SHEFFIELD.	
Charles Green	23 a.
Reuben Townroe	23 a.
Charles Chambers	8 a.
Read Turner	16 a.
Henry Theaker	6 a.
John Brooks	6 a. 3 b.
George A. Illston	10 a.
Thos. Jones	22 d.
James Gamble	19 a.
John Maxfield	18 a.
William Allen	23 a.
Hugh Stannus	23 a. 23 c. 22 c.
George Theaker	16 a. 23 a. 19 a.
Waller Nicholson	5 b. 10 a. 13 a.
Robt. Wm. Brooks	2 b.
William Bramall	6 a.
Sibilla Vickers	4 b.
Howard M. Ashley	22 d.
William Firth	22 d.
Charles Hoole	8 b.
George Harrison	18 a.

Names of Students.	Stages.
SCHOOLS OF ART:	
SOUTHAMPTON.	
John Sharp	3 b.
George Waller	16 a.
Harriette P. Lonsdale	14 a.
STOURBRIDGE.	
Frederick Row	4 b.
John Northwood	11 b.
Thomas Charles Smyth	8 a.
SWANSEA.	
Not examined this year. No Local Medals were awarded.	
TAVISTOCK.	
William Simons	2 b.
John Moyse	4 b.
Felix Pearce	3 b. 6 a.
F. R. Robjohns	5 b.
TAUNTON.	
New School.	
TRURO.	
Edith Dunn	4 b. 15.
Henry Dunn	12 a.
Jane Gattey	7 b.
Maria Jenkins	6 b.
WARRINGTON.	
Edward Brew	19 a. 8 a.
Wm. Caldwell	3 b.
Wm. Fell	15. 23 c.
James Ingham	10 a. 6 a.
John Johnston	14 a.
Josiah Whittle	22 d.
James Waldron	2 b.
Marie Webster	22 c.
Emma Court	2 b. 10 a.
Catherine Court	3 a.
Mary E. Edelsten	7 a.
Agnes Gaskell	15.
Rebecca Gaskell	2 b.
Ellen Whittle	13 a. 14 a.
Mary Jane Whittle	6 b.
Sarah White	12 a. 22 c. 22 d.

Appendix E.

LOCAL EXAMINATIONS OF STUDENTS' WORKS.

Names of Students.	Stages.
SCHOOLS OF ART:	
WATERFORD.	
Elizabeth Jones - -	2 b. 12 a.
Maria Moore - - -	14 a.
Octavia Peet - - -	22 c.
Katherine Strangman -	14 a. 15.
Harriett Coombe - -	22 c.
WENLOCK AND COALBROOKDALE.	
New School.	
WOLVERHAMPTON.	
Francis Cheshire - -	2 b.
Charles Gregory - -	3 b.
Edward Fletcher - -	5 b.
Francis Perks - - -	3 b.
William Leech - -	4 b.
Thomas Twigg - -	12 a. 16 a.

Names of Students.	Stages.
SCHOOLS OF ART:	
WORCESTER.	
William Clarke - -	5 b.
John Hopewell - -	13 a.
Luke Wells, jun. - -	14 a. 11 a.
Henry Gummery - -	14 a. 23 h.
Alfred Chamberlain - -	2 b.
James Hadley - - -	8 a. 18 a. 19 a.
Thomas Adams - -	22 c. 17 a.
Luke Wells, sen. - -	17 a.
Julia Wilcox - - -	4 b.
Fanny Blood - - -	13 a. 23 c.
Amelia Hanbury Hopkins -	13 a.
Maria Maybury - -	15 a.
Helen Darke - - -	15 a. 16 a.
Thomas Callowhill - -	6 a.
Josiah Rushton - -	8 b. 17 a. 23 h.
Thomas A. Bickerton -	19 a.
YORK.	
Not examined this year.	

CONDITIONS OF REWARDS, AND SPECIAL PRIZE LIST FOR ADVANCED STUDIES

For the Year 1857–8.

I. The nature of the works to be submitted for inspection, in the various stages previous to stage 23, and the examples from which they are to be prepared, are defined in the paper No. 127 (see p. 17).

II. The conditions given in paper No. 127, are to be strictly and literally adhered to, as regards *size* and all other respects. No work will be rewarded which does not conform to them as well as the requirements of this programme.

III. Particular attention is requested to the regulations as to the mode of *mounting*, borders, or other accompaniments of drawings; extreme simplicity in this respect being recommended; quiet, unobtrusive tints should be selected when coloured mountings are deemed requisite: and, as a general rule in such cases, all primary or secondary tints are to be avoided.

IV. In the various stages which constitute the painting course, especially in the studies consisting of arrangements of objects, such as fruit, flowers, shells, &c., although the special qualities of *colour*, light, and shade, general pictorial effect, and an agreeable distribution of forms, are primary considerations, still the severe and imitative treatment is not to be sacrificed: the same earnest, truthful rendering of the actual facts of the objects represented, will be looked for in these compositions, as in isolated studies; and all attempts at the acquisition of premature facility of execution should be discouraged.

V. The masters of the various Schools of Art are requested to give their particular attention to an increased development of the studies in stage 22 (Elementary Design). [See Mr. Redgrave's Report on the Works exhibited, 1853, p. 31, Catalogue of the Works of the Schools in 1853, and those for the Works exhibited in the spring of 1854.]

VI. Original designs for manufactures must have been executed by pupils who, having actually received their instruction in the schools, are supposed to carry out their designs upon the principles taught therein. The works of established designers, who may have only been casual students in the schools, and whose general practice has not as yet become sensibly influenced by the teaching of the schools, are obviously not required. Neat and precise execution in all original designs should be inculcated.

VII. To each work must be attached a ticket showing—1. The name of the school from which it is sent. 2. The name and age of the student. 3. His present or prospective occupation. 4. The length of time he has studied in the school. 5. The stage to which the work belongs. 6. The signature of the Head Master, and the date. 7. Prices may also be attached to works of importance, for the convenience of purchasers. These tickets are supplied by the Department. They are to be neatly filled up. The *white* tickets placed on white paper, and the *coloured* tickets on paintings, &c.

VIII. No student can receive a *second* medal for a second work in the same stage, except that of "Applied Designs." For instance—the student who has received a medal in stage 9 in 1857, cannot send again

Appendix E. Special Prize List.

another work in stage 9 in 1858,—but he may send a work in any *other* stage, or section of a stage, in which he has not been rewarded. In stage 23 the student may take medals in *two* successive years, in the same section, and money prizes according to Rule XXII.

IX. A printed list (of which forms will be furnished), properly filled up, is to be forwarded by the Inspector with the works sent in competition for the National Medals, and a duplicate of the same to be retained in each school. The list transmitted to the Department may be accompanied by any remarks or observations which are deemed explanatory or useful.

Applied Designs.

X. With regard to the 23d stage, "Applied Designs," the Examiners have "suggested that all manufactured articles should be accompanied by the original design; or, when that is not possible, that the Master should certify that such design has not been materially changed in the process of manufacturing, and that he is satisfied with the mode in which the design is rendered. With respect to more absolute grounds for decision, we conceive that such works only should be rewarded as may be in conformity with the principles of taste taught by the masters and by the professor in the peculiar department."

XI. Accordingly, it has been determined that the following conditions must be observed, and that medals, with books, and certain sums of money, shall be awarded to designs produced according to the principles hereafter laid down, and to the under-mentioned classes of manufactures. Designs, or works executed in disregard of these principles and conditions, will not be eligible for reward. Rewards will be wholly or partially withheld if the works sent in to compete for them are not considered of sufficient merit to warrant their being awarded. The competitors for the reward herein offered, must have been students in the school during the past year, must state their age, and what length of time they have been students, and *what stages of instruction they have passed through.*

XIII. In *Calicoes, Cambrics, Chintzes, Muslins, Mousselines de laines,* and other printed garment fabrics. The following rules must be observed in the designs for the decoration :—

1. The ornament must be flat, not imitative but conventional, without relief, shadow, or perspective. 2. If the decoration is derived direct from natural objects the designs must be accompanied by a sheet of imitative studies of the subjects on which they have been founded. 3. The ornament must cover the surface either by a diaper, based on some regular geometrical figure, or arise continuously out of itself by graceful flowing curves. 4. No pronounced lines should lead in the direction of breadth. 5. The effect produced by the folding of the stuff must be carefully studied. 6. The size of the pattern must be regulated by the material for which the design is intended—small, for close thick fabrics, such as ginghams, &c.; larger, for fabrics of more open textures, such as muslins, barèges, &c.; largely covering the ground on *de laines;* more dispersed in cotton or linen goods. 7. The colours employed must be such as the manufacturer can produce, and the most careful attention given to arrange them according to their laws of harmonious relation. 8. The pattern must be properly studied as to the necessary repeats, and the means of production either by block or cylinder.

Silks.

XIV. The rules 1 to 6, as in calicoes, must be observed in the designs for silks, together with the following :—

The size of the pattern must be regulated by the strength of its contrasts either of light and dark or colour; the stronger the contrast the smaller

must be the pattern. The processes of weaving must be considered both as to the power of producing the arrangement of colour adopted, and as to the enrichment of the stuff by the interchange of surface; and the laws of harmony of colour must be thoroughly observed.

Carpets.

XV. The following rules must be observed in the designs for the decoration of carpets :—

A carpet serves as a "ground" to relieve all objects of furniture upon it, and should be quiet and negative—without strong contrast of either form or colour. The leading forms must be so composed as to distribute the pattern over the whole floor, not pronounced either in the direction of breadth or length ; all "up and down" treatments being only suitable for passages or staircases. The decorative forms must be flat, without shadow or relief, whether derived from ornament, or direct from flowers or foliage. In colour the general ground should be negative, low in tone, and inclining to the tertiary hues—the leading forms of the pattern being expressed by the darker secondaries—and the primary colours or white, if used at all, only in small quantities to enhance the tertiary hues. The laws regulating the harmonies and contrasts of colour must be strictly attended to, as well as the necessary conditions of manufacture. The mode of manufacture must be stated, whether Brussels, tapestry, or printed carpet.

Paper Hangings.

XVI. The following rules must be observed in the designs for paper hangings :—

Paper hangings should be treated as a background to display the furniture and other objects in the apartment. Its decoration must be subdued and unobtrusive, not inviting special attention by strongly pronounced contrasts either of form or colour. All the ornament employed must be strictly conventional, flat, and without relief; the forms may be purely ornamental or based upon natural objects; they should cover the surface equally, and where a geometrical basis filled in with smaller forms is used, care must be taken so to construct these leading lines that the eye may pass continuously over the suface without break or interruption of line. The treatment of colour may consist of gradations of one hue or combinations of different hues or tints, which, however, must be in strict accordance with the laws of harmonious combinations of colour. As the colours should be regulated by the aspect of the room, and the character of the design by the nature of the apartment, whether drawing-room, dining-room, library, or bed-room, and also by its size, it will be necessary that to all designs, the size and nature, and proposed aspect of the apartment for which they are intended should be appended. The design should not exceed 1 ft. 9 in. width, nor 2 ft. 7½ in. in length.

Pottery.

XVII. The following rules must be observed :—

The best form for use and capacity must have the first attention of the designer, and then the most graceful treatment of that form. All projecting parts must have careful consideration to render them as little liable to injury as is consistent with their purpose, and all relief ornament so treated that it is as little injured by the glaze as possible.

Metal Work.—Jewellery.

XVIII. The following rules must be observed in the designs for metal-work :—

Whatever article is chosen as the subject of the design it must first be carefully constructed and its form thoroughly adapted to use, being

Appendix E. Special Prize List.

studied for elegance and beauty of line, as well as for capacity, strength, mobility, &c. The structure of the design must be shown, in outline or otherwise, in this stage, without decoration. In ornamenting this construction, care must be taken to keep the decoration subordinate, and to preserve the general form, by low relief or otherwise; the ornament must be so arranged as by its lines to enhance the symmetery of the original form and assist its constructive strength. If arabesques or figures in the round are used, they must arise out of the ornamental and constructive forms, and not be merely applied. Variety may be obtained by parcel-gilding, burnishing, tooling, inlaying, or enamelling; but it must ever be remembered, that repose is required to give value to ornament, which in itself is secondary and not principal. Where parcel-gilding or enamels form part of the design they should be shown by separate drawings.

Wall Decoration.

XIX. The general principles already laid down for the decoration of surfaces and for construction must be observed.

XX. Copyright.

The copywright of all works is the property of the student, but the actual works to which the prizes of the Department are awarded must be preserved in the Department. The authors of them will, however, have every facility in making duplicates of them.

XXI. A student who has taken any money prize in one section of designs cannot take afterwards a prize of *lower* value in the same section; and having taken the highest prize, cannot take another of the same value in the same section, but is eligible to take a prize in a *different* section, without limit as respects the number of sections.

In accordance with the suggestions of the examiners, the special prize list, as far as regards money rewards, will be for the present discontinued, until the spread of art-education, and the efforts which are being made in the training school to prepare highly qualified teachers, shall ensure a fuller and better competition for them. But, in the mean time, the examiners will be at liberty to recommend in meritorious cases, in addition to the medals for "applied designs," such money rewards, under the usual restrictions, as they may consider suitable.

RETURN of VISITORS to the EXHIBITION of PRIZE DRAWINGS of the PROVINCIAL SCHOOLS of ART, from the 1st of January to the 13th June 1856.

SCHOOL.	Time open.		Visitors.		
	Days.	Evenings.	Morning.	Evening.	Total.
Aberdeen - -	4	4	1,735	1,580	3,315
Paisley - - -	4	5	487	2,095	2,582
Glasgow - -	4	4	973	2,267	3,240
Belfast - - -	4	4	1,100	1,205	2,305
Dublin - - -	4	3	1,325	373	1,698
Limerick - -	4	4	597	694	1,291
Cork - - -	4	4	1,935	2,857	4,792
Clonmel - -	4	4	660	729	1,389
Waterford - -	3	3	1,565	1,571	3,136
Carnarvon - -	4	4	983	3,755	4,738
Sheffield - -	4	4	976	4,233	5,209
Worcester - -	3	3	1,082	1,237	2,319
Hereford - -	4	4	337	481	818
Carmarthen - -	4	4	981	1,717	2,698
Swansea - -	4	4	540	443	983
Bristol - - -	4	4	1,976	1,289	3,265
Exeter - - -	9	9	- -	- -	2,739
Truro - - -	4	4	1,957	4,144	6,101
Penzance - -	4	4	1,362	768	2,130
Plymouth - -	4	4	2,530	2,640	5,170
Tavistock - -	3	3	1,043	990	2,033
Southampton - -	4	3	388	150	538
			24,532	35,218	62,489

APPENDIX F.

List of Public Schools and Institutions which have been supplied with Examples by the Department of Science and Art, from 1st January to 31st December 1856. In continuation of Return at p. 265 of Third Report.

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	No. of Pupils or Members. F.	Aid by Department. £	s.	d.
Aberdeen	School of Art	A. Yeats	83	24	1	5	6
	East Parish Sessional School	J. S. Kidd	70	30	1	16	11
Aigburth	Working Men's Improvement Society.	T. Williams	25	. .	1	1	3
Ashford	National School	T. H. Vie	210	130	1	3	3
Ashton-in-Makerfield.	St. Oswald's School	W. B. Leaper	. .	. .	0	8	0
Ashton-under-Lyme.	Mechanics' Institute	J. Mills	15	. .	0	9	10
Astbury	National School	Rev. O. Crewe	70	87	0	12	10
Bailieborough.	District Model School	J. Kelly	. .	. .	9	14	0
Ballymena	Ditto	Ditto	. .	. .	7	5	10
Bangor	British School	H. Owen	. .	. .	0	1	9
Bath	Rectory and Commercial School.	Rev. J. James	60	. .	1	14	0
Basingstoke	British School	R. Wallis	130	40	0	14	0
Belfast	School of Art	J. D. Croome	. .	. .	18	14	6
	Victoria Place National School.	J. Kelly	. .	. .	1	15	9
	Calendar Street do.	Ditto	. .	. .	1	15	9
	Fountain Street do.	Ditto	. .	. .	1	15	9
	Gymnasium do.	Ditto	. .	. .	1	15	9
	Donegal Street do.	Ditto	. .	. .	1	15	9
	Townsend Street do.	Ditto	. .	. .	1	15	9
Berwick-upon-Tweed	Mechanics' Institute	D. C. Majoribanks	. .	. .	7	0	4
Birkenhead	Workman's Institute	W. H. Hatcher	. .	. .	1	2	1
	School of Art	W. Foster	. .	. .	2	10	6
	Working Man's School	Rev. A. Knox	. .	. .	2	5	1
Birmingham	Midland Institute	W. M. Williams	. .	. .	13	12	5
	Messrs. Chance's School	J. C. Chance	63	14	1	13	6
	King Edward's Branch School.	Rev. E. H. Gifford	500	500	8	14	0
	School of Art	Geo. Wallis	594	112	1	5	7
	Cambridge Street School	T. J. Winfield	50	. .	0	16	1
Bishop's Stortford.	High School	Rev. G. Goodman	50	. .	1	12	9
	Training School	C. Swinstead	. .	48	1	15	6
Blackwood	Courty Bella School	Thos. Phillips	154	110	2	6	8
Bolton	Mechanics' Institute	J. Barrow	442	4	1	7	7
Boston	National School	W. Gane	120	. .	1	13	2
Bradford	Clayton National School	Rev. T. H. Manning	75	65	1	15	8
Brampton Bierlow.	National School	Rev. W. Partington	95	71	1	10	1
Brechin	Burgh School	T. Picken	46	39	0	11	8
Brightstone	National School	Rev. E. McAll	65	40	1	3	8
	Oldland Common British School.	A. Chinn	110	114	1	3	2
	St. Paul's Parochial School	Rev. A. Rogers	. .	. .	1	12	10
	Clifton National School	W. W. Gibbon	187	. .	0	19	2
Bristol	St. Michael's National School	W. Knight	96	50	0	19	1
	Hannah More School	D. Cooper	120	90	1	4	8
	Diocesan Trade School	. .	. .	. .	39	7	0
	Lewin's Mead British School.	Mrs. Thomas	98	80	2	5	3
Broseley	School of Art	J. Burnet	25	5	7	10	2
BrownCandover	Parochial School	Rev. F. V. Thornton	55	44	5	8	4
Burslem	School of Art	W. J. Muckley	40	15	3	18	6
Bury	Athenæum	J. Pomfret	640	39	0	7	0
Bushbury	National School	Rev. W. Lester	71	56	1	3	7
Bywell	Village School	Thos. Sopwith	37	35	2	1	3
					£176	12	6

Appendix F.

List of Schools, &c. supplied by the Department.

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	F.	Aid by Department. £	s.	d.
	Brought forward				176	12	6
Candover	Literary Institution	W. Pettit	32	25	1	10	7
Carlisle	Chiswick Street School	Thos. Johnson	51		0	13	2
	Abbey Street School	J. Hannah	105	35	0	19	9
	School of Art	D. McAlpin			1	9	5
Carmarthen	School of Art	S. C. Davison			1	18	5
Chardstock	National School	Rev. C. Woodcock	75	60	4	3	4
Cheltenham	Grammar School	Dr. Wright			3	11	8
	Training College	Rev. C. H. Bromby	97		1	16	9
	Ladies' College	Mrs. Proctor		106	0	15	4
Chepstow	Young Men's Christian Institution.	Rev. T. E. Moncrieff	35		1	16	5
Chester	School of Art	Rev. A. Rigg	32	13	1	19	11
Christleton	Boys' School	J. Constable	90		0	4	10
Coalbrookdale	School of Art	W. G. Norris			15	11	11
	Boys' School	W. G. Norris	80		1	2	5
Coatbridge	St. Patrick's Roman Catholic School.	Rev. M. O'Keeffe		128	0	9	10
Conway	National School	Rev. W. Morgan	109		0	19	9
Cork	St. George Street National School.	J. Kelly			1	10	2
	Douglas Street do.	Ditto			1	10	2
	St. Nicholas do.	Ditto			1	10	2
	School of Art	T. S. Dunscombe			13	4	1
	Christian Brother's School	Rev. T. B. Lennard	1,300		8	6	9
	St. Patrick's National School	J. Kelly			1	10	2
Coventry	School of Art	R. Caldicott			0	14	0
Cromhall	Middle School	Earl of Ducie	30		0	12	0
Croydon	National School	Rev. T. G. Hodgson	140		4	11	4
	British School	R. C. Crafton	270		3	8	0
Darlington	Trinity National School	H. Armstrong	136		1	18	1
Dawley	Coalbrookdale Company's School.	W. G. Norris	127	130	4	3	3
Devonport	St. James' National School	Rev. E. B. Hutchison	100	40	2	8	0
	Royal Naval and Military School.	Capt. Hillyer, R.N.	411	269	1	1	6
Dublin	School of Art	Dr. Steele			5	2	3
	School of Christian Brothers	Rev. A. Maxwell	600		3	16	8
	Normal Lace School	Miss Bruce		25	2	14	1
	Museum of Irish Industry	J. J. B. Jukes			0	9	5
	Central Model Schools	T. W. Young			10	11	2
	West Dublin Model School	J. Kelly			9	15	7
Dundee	Watt Institution	W. Miller	481	19	1	6	4
	School of Art	P. Anderson			5	7	2
	St. Peter's School	D. Macdonald	120	100	0	4	6
	St. John's Free School	D. Petrie	90	40	0	9	10
	General Sessional School	J. Hamilton	333	165	0	7	8
Duntocher	Public School	J. P. Meikle	61	56	1	9	9
East Retford	Working Men's Association	Jno. White	100		1	13	11
Edinburgh	Free Church Training School	J. Syme	70	53	1	18	0
	St. George's Local School	J. Simpson	82	88	1	16	11
Elford	National School	Rev. F. Paget	36	31	1	6	7
Ely	Cathedral School	Rev. J. Ingle	33		1	8	5
Errol	Free Church School	D. Ross	50	20	0	13	1
Exeter	Devon and Exeter National School.	Rev. S. Lee	160		0	14	8
	Devon and Exeter Central School.	Ditto	168		0	14	8
Frampton Cottercll.	British School	S. Tomkins			0	4	0
Gilling	National School	Rev. T. C. Wharton	65		3	2	3
Glasgow	School of Art	C. H. Wilson			2	0	1
	Mechanics' Institute	C. Wingate	283		0	16	11
	Training Academy	A. D. Robertson			0	6	8
	St. David's Parochial School	J. Dickie	210	170	0	19	4
	St. Enoch's School	Alexander Sim	265	170	2	14	1
					£324	7	3

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	F.	Aid by Department. £	s.	d.
	Brought forward	. . .	. .	. .	324	7	8
Glasnevin .	Model Farm . . .	J. Kelly . . .	. .	. .	7	6	0
	Literary Training Institution . . .	J. Kelly . . .	. .	. .	10	16	10
Gloucester .	National School . . .	J. Swornsbourne .	160	. .	0	14	11
Godalming .	Commercial School . .	W. Mason . .	17	. .	1	3	0
Great Driffield	Mechanics' Institution .	J. D. Whitaker .	130	16	0	11	1
Hanley . .	School of Art . . .	T. C. Hodgetts .	33	25	0	7	3
Hanwell . .	National School . . .	Rev. C. Clarke .	. .	. .	1	2	10
Haverfordwest	Ditto	J. L. Davies . .	130	. .	0	5	8
Hawkhurst .	Ditto	Thomas Humphrey .	. .	. .	0	8	3
Higham . .	National School . . .	James Hindle . .	. .	. .	0	12	2
Howden . .	Wesleyan Day School . .	Thomas Ward .	21	25	0	10	8
Huddersfield .	Mechanics' Institute . .	F. Curzon . .	. .	. .	0	10	10
Idle. . .	National School . . .	C. M. Hall . .	138	. .	1	18	11
Illogan . .	National School . . .	Rev. J. G. Wulff .	160	. .	3	5	0
Inchicore .	Railway Model School .	J. Kelly . . .	. .	. .	9	15	7
Ipswich . .	Christ's Hospital School .	T. P. Howe . .	23	. .	1	19	8
	Wesleyan School . .	J. Peachey . .	140	50	1	1	1
	British School . . .	J. C. Champness .	208	. .	1	8	0
Ireland . .	National Model Schools .	Dr. Clarke, and the Secretaries, Education Office, Dublin . .	. .	. .	25	8	3
Keighley. .	Mechanics' Institute . .	J. Pickles . .	. .	. .	0	9	5
Kidderminster	School of Design . .	E. G. Saunders .	22	. .	3	10	11
Kilkenny .	District Model School .	J. Kelly . . .	. .	. .	7	6	0
Kilmarnock .	Academy	J. Graham . .	180	65	1	5	8
	Town Head District School	D. Ferguson . .	200	100	2	2	9
Kingswinford .	St. Mary's School . .	W. Abbott . .	96	40	0	16	11
Lancaster .	School of Art . . .	W. Whelon . .	. .	. .	36	3	8
Leeds . .	Mechanics' Institute .	A. McIvor . .	130	60	6	8	3
	West End People's Institute	Ditto . . .	36	. .	1	1	8
Leicester. .	Young Men's Christian Association.	J. Penticost . .	300	. .	3	1	3
Leiston . .	National School . . .	J. Cotton . .	51	60	0	14	6
Leominster .	British School . . .	J. Newman . .	80	60	2	10	2
Letham . .	Monimail Subscription School	W. Leitch . .	51	26	1	11	5
Leven . .	Scoonie Parochial School .	Henry Smyth .	110	56	2	1	4
Lewes . .	British School . . .	A. Greening . .	100	. .	1	2	5
Lilleshall .	National School . . .	Rev. G. Bunsen .	. .	. .	0	9	4
Limerick. .	School of Art . . .	T. Clack . . .	49	36	3	4	9
	Model School . . .	J. Kelly . . .	142	117	8	9	8
Liscard . .	New Brighton School .	Rev. D. D. Fowell .	90	70	1	8	0
Liskeard . .	British School . . .	John Pearson .	200	160	1	12	5
Liverpool .	Roman Catholic Training School.	Mrs. Lescher . .	. .	22	4	0	1
	Hibernian School . .	C. Rathbone . .	300	150	1	12	0
	St. Francis Zavier's Roman Catholic School.	Rev. R. O. Carroll .	191	. .	4	19	6
	Mount Pleasant School .	A. Thorneby . .	40	. .	1	4	3
	South District School of Art.	A. Cariss . .	201	. .	8	14	9
	St. Thomas' School . .	R. Andrews . .	230	190	1	15	1
	St. Swithin's Roman Catholic School.	Rev. E. Morrin .	60	60	2	12	10
	St. Andrew's National School.	T. C. Cowan . .	100	120	0	15	10
	St. James' School . .	Rev. F. L. Thomas .	243	224	0	8	0
	Collegiate School for Girls	Rev. J. S. Howson .	. .	36	1	10	7
	Collegiate Institution .	Ditto . . .	50	. .	0	12	8
	St. Matthias' School . .	Rev. R. B. Sheldon .	. .	. .	1	15	6
Llandegai and Tyntwr	National School . . .	Col. Pennant . .	240	12	2	16	10
Llangollen .	British School . . .	J. Griffiths . .	120	96	0	17	8
Lockwood .	Mechanics' Institute . .	Alfred Lee . .	170	31	0	3	3
					£513	3	0

Appendix F.

LIST OF SCHOOLS, &c. SUPPLIED BY THE DEPARTMENT.

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	No. of Pupils or Members. F.	Aid by Department. £	s.	d.
	Brought forward	. . . .	. .	. .	513	3	0
	Clapton Orphan Asylum	H. V. Lynes . .	. .	24	0	16	5
	Westminster Birkbeck School.	J. Rüntz . .	50	. .	3	15	11
	Highbury Training College	John Martin . .	66	. .	2	10	2
	Lambeth, George Street British School.	J. Horrocks . .	200	. .	0	9	0
	Westminster, St. Stephen's School.	Mrs. H. Bang . .	. .	11	0	18	6
	Marylebone, Western National School.	W. Kimpton . .	200	50	0	15	9
	South Islington British School.	G. Hardy . .	340	. .	0	3	5
	Birkbeck School . .	G. Rüntz . .	170	. .	0	17	4
	Kennington, Bolton Street School.	Rev. C. Lane . .	. .	. .	1	1	8
	Marylebone Trinity National School.	J. J. Farnham .	50	30	1	4	0
	Battersea Training College	Rev. S. Clarke .	112	. .	0	7	9
	Camden Town National School.	W. Howitt . .	240	200	2	18	5
	Turnham Green National School.	C. Lawrence . .	102	. .	0	19	1
	Peckham Birkbeck School	W. A. Shiels . .	250	100	0	10	2
	Brompton Parochial School	J. Burton . .	113	102	1	2	2
	St. Sepulchre's School .	A. Pearson . .	119	51	0	6	6
	London Temperance League	W. Tweedie . .	200	. .	2	0	10
	St. Pancras Trinity National School.	Rev. D. Laing .	190	150	0	10	8
	Peckham, Camden do. .	H. Kemp . .	50	. .	0	16	7
	Farringdon School, Harp Alley.	T. Johnson . .	180	200	0	13	8
	Westminster, St. James' National School.	Rev. J. E. Kempe .	48	. .	0	12	0
	Marylebone, Portman Schools.	J. Michaux . .	45	18	1	5	7
	Bow, Coborn School . .	F. J. Marshall .	120	90	0	13	4
	Poplar Trade and Navigation School.	W. H. Bolt . .	68	. .	2	2	2
London . .	Baldwin's Gardens National School.	John Martin . .	165	100	0	13	9
	Christ's Hospital School .	W. H. Back . .	90	. .	1	5	7
	Mile End New Town, Church Street Schools.	Rev. W. Tyler .	90	. .	0	19	1
	Hackney Road, Adelphi Church British School.	S. Stacey . .	25	. .	0	11	0
	Clapham Boys' Parochial School.	E. Heller . .	200	. .	1	9	2
	Kingsland Birkbeck School	G. Rüntz . .	150	50	0	11	6
	Fulham, St. John's National School.	Rev. W. Garratt .	20	22	0	18	10
	Islington, All Saints' National School.	Rev. T. Sanley .	241	163	0	18	3
	St. John's Wood National School.	F. R. Crampton .	180	. .	0	11	2
	Wandsworth Trade School	J. C. Buckmaster .	105	. .	0	1	9
	West Metropolitan Jewish School.	Emma Gill . .	. .	60	0	3	5
	St. Martin's Northern School	R. G. Maul . .	. .	. .	0	3	5
	Bethnal Green Birkbeck School.	R. W. Pike . .	60	25	3	11	6
	St. Mary's Tothill Fields School.	Rev. A. Borradaile .	154	42	0	10	10
	Walworth, St. Peter's National School.	John Church . .	300	300	0	2	7
	Lambeth, Hawkstone Hall School.	J. Rüntz . .	41	. .	0	3	6
	Upper Chelsea Trinity National School.	C. Gooding . .	250	150	0	2	7
	Upper Albany Street, Christ Church National School.	Rev. H. W. Burrows	210	. .	0	3	6
	Hampstead District School of Art.	R. Burchett . .	. .	. .	23	9	8
					£577	5	2

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	No. of Pupils or Members. F.	Aid by Department. £	s.	d.
	Brought forward				577	5	2
	Nutford Place Diocesan School.	A. Holliday	145	122	0	12	11
London	Stepney, St. Peter's National School.	N. S. Wilkins	150	170	1	1	1
	Rotherhithe Parochial School.	Rev. E. Blick	150	150	0	7	6
Lowestoft	St. Paul's Bentinck School	W. T. Chambers	120		0	11	1
	St. John's Parochial Library	Rev. M. H. Beaumont.	200		3	6	4
Macclesfield	School of Art	J. Kelly			4	0	5
Madeley	National School	C. F. Ferriday	90	80	0	12	0
	District School of Art	J. Austice			7	11	9
	Worsley Mechanics' Institute.	J. A. Hammersley	25	15	1	8	0
	Longsight do.	Ditto	20		1	4	6
	St. John's National School	J. Matheson	128		3	0	8
	Dob Lane Mechanics' Institute.	J. A. Hammersley	14		0	12	8
Manchester	Worsley Literary Institution.	Rev. S. V. Beechy	300		3	1	8
	Pendleton, St. George's National School.	Rev. H. M. Harmar	90	56	1	1	8
	St. Paul's School	Rev. H. W. McGrath	76	67	0	19	3
	Commercial School	J. A. Hammersley	24		0	13	3
Messingham	National School	Rev. J. Bowstead	59	21	1	0	2
Milverton	Parish School	Rev. J. H. Sotheby	81	67	1	1	7
Mold	British School	Thomas Jones	126	109	0	4	0
Morley	Wesleyan School	J. Rymer	125	90	0	9	0
Moseley	National School	Rev. J. R. Davison	78	44	0	19	1
	Trade School	Rev. C. Moody			19	12	8
	St. Andrew's National School.	George Gibb	200		2	2	3
Newcastle-upon-Tyne.	St. John's do.	J. Forster	240		1	7	8
	St. Thomas' do.	H. Page	280		1	15	5
	St. Nicholas' do.	Thomas Hara			1	7	7
	School of Art	W. B. Scott	91	18	1	0	5
	All Saints' Charity School	J. Brewis	71	40	0	11	3
Newry	District Model School				9	14	0
Norwich	School of Art	C. L. Nursey			0	12	7
	School of Art	W. Richards			0	17	0
Nottingham	Trinity National School	R. Thurlow	240	105	1	9	0
	People's College	T. B. Smith	200	70	0	5	2
Paisley	Neilson Educational Institute.	A. Gardner	500	100	1	3	0
	School of Art	W. Stewart			3	7	9
Penzance	School of Art	H. Geoffroi			2	11	8
	National Day School	Ditto			1	6	1
Petersfield	District School of Art	Rev. J. Williams	16	22	2	15	0
Plymouth	School of Art	E. Iago	70	10	22	3	3
	Charles' National School	H. Ewers	412	307	2	16	6
Pontefract	British School	J. E. Robinson	129	96	1	18	7
Prestwich	Ditto	J. Chadwick	80	60	0	7	2
Rugby	St. Matthew's Parochial School.	Rev. W. Taif	80	50	1	5	1
	Rugby Institute	Rev. C. Evans	20		0	18	9
St. Andrew's	National History Society	J. Howie			1	2	1
St. Ewe	Parochial School	Rev. J. J. Treveuen	80	55	0	16	10
St. Neot's	Wesleyan School	J. Cooper	90	40	1	4	5
St. Peter's, Isle of Thanet.	National School	Rev. J. Hodgson	110	100	4	12	10
					£700	7	9

Appendix F.

LIST OF SCHOOLS, &c. SUPPLIED BY THE DEPARTMENT.

Locality.	Name of School or Institution.	Name of Requisitionist.	No. of Pupils or Members. M.	No. of Pupils or Members. F.	Aid by Department. £	s.	d.
	Brought forward				700	7	9
Settle	National School	W. F. Pierson	66	46	1	11	9
Sheffield	School of Art	Y. Mitchell			2	8	7
Sherston	British School	S. Gossling	60	61	0	6	0
Shrewsbury	School of Art	W. O. Williams	27	10	22	19	11
Skipton	British School	R. Gibbs	160	140	2	0	10
Slough	Mechanics' Institution	G. Kershaw	143	1	0	16	10
Southampton	School of Art	W. J. Baker	55	10	0	7	6
	St. Luke's Boys' School	Rev. F. Russell	20		0	18	5
	St. Mary's National School	R. Kimber	230		1	1	6
Spalding	National School	R. Hollis	143		2	15	1
Stoke-upon-Trent.	School of Science	Thomas Leech	64		1	0	1
Tankersley	Church of England School	J. Beauland	55	60	0	17	1
Taunton	School of Art	Rev. W. A. Jones			21	12	5
Tavistock	Ditto	W. Robjohns			0	8	2
Tortworth	British School	Earl of Ducie	160		0	6	10
Tralee	Christian Schools	R. A. Maxwell	400		3	16	9
Truro	Mining School	W. H. Bond	10		13	1	9
Wakefield	Mechanics' Institute	J. Lockwood	782	30	1	4	1
Wargrave	National School	Rev. J. Whitley	120	88	1	7	5
Warrington	British School	G. Brewtnall	300	80	0	7	6
	Parochial School	R. G. Gray	168		0	7	6
	School of Art	E. Brewtnall			4	11	3
Waterford	District Model School	J. Kelly			7	5	10
Wenlock	Borough School of Art	W. G. Norris			5	3	3
	Agricultural Reading Society.	W. P. Brookes			10	11	0
Wentworth	Mechanics' Institute	F. Moore	104	4	2	14	2
West Bromwich	Wesleyan School	J. Hall	70	12	1	0	0
West Hartlepool.	Mechanics' Institute	C. Salmon	346	19	1	4	8
Wimborne Minster.	Grammar School	W. Taylor	12		3	3	6
Windsor	British School	John Atkins	160		1	4	9
Winkfield	School of Industry	C. C. Ferard	35	42	0	15	5
Wisbech	Mechanics' Institute	G. Dawbarn	40	15	3	2	5
Withyham	St. Michael's School	Hon. and Rev. R. S. West.	30	24	1	4	4
Woburn	Mechanics' Institute	W. Farrow			6	1	5
Wolverhampton	Snowhill British School		145		0	14	0
	School of Art	T. Chittenden			0	6	10
Worcester	Boys' British School	S. Pumphrey	160		0	13	7
York	School of Art	J. C. Swallow	230	102	0	13	4
					£830	13	6

APPENDIX G.

A STATEMENT OF THE EXPENDITURE OF THE DEPARTMENT OF SCIENCE AND ART, FOR THE FINANCIAL YEAR ENDING 31st MARCH 1857.

No. 1. General Management.

	£	s.	d.
Salaries	2,525	18	5
Incidental Expenses	798	14	4½
	£3,324	12	9

No. 2. Department of Science and Art.

Heads of Service.	Jermyn Street.			Marlborough House.			Museum, Scotland.			Museum, Ireland.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Salaries of principal Officers	2,876	15	0	840	16	9	300	0	0	600	0	0	4,617	11	9
Wages of Subordinate Officers	574	19	6	1,558	18	4	310	11	0	349	16	0	2,794	4	10
Salaries of Professors	1,700	0	0	300	0	0	100	0	0	1,100	0	0	3,200	0	0
Provincial Lectures	-	-	-	-	-	-	-	-	-	500	0	0	500	0	0
Museums and Libraries	683	12	4	2,501	10	0	1,229	9	8	502	9	7½	4,917	1	7½
Laboratories	99	8	2	-	-	-	-	-	-	99	19	5½	199	7	7½
Rent, Rates, and Taxes	-	-	-	-	-	-	-	-	-	228	3	6	228	3	6
Ordinary Repairs, Furniture, Fittings, &c.	-	-	-	-	-	-	184	10	10½	1,462	12	4½	1,647	3	3
Police Attendance	55	4	0	25	3	0	-	-	-	-	-	-	80	7	0
Fuel and Light for general purposes	185	17	6	569	16	2	49	13	8½	149	18	9	955	6	1½
Soap, scouring, and cleaning articles	9	10	8	36	0	3	38	0	9½	50	18	10	134	10	6½
Uniforms for Attendants, &c.	-	-	-	-	-	-	-	-	-	50	0	0	50	0	0
Advertisements and Printing	249	17	0	416	6	5	13	10	0	98	9	6	778	2	11
Travelling Expenses	100	0	0	-	-	-	12	13	1	20	19	7	133	12	8
Incidents and various small disbursements	379	9	2	934	19	8	48	19	10½	109	0	0½	1,472	8	9
Prizes and Examinations	55	0	0	-	-	-	-	-	-	24	0	0	79	0	0
Illustration for Catalogues	-	-	-	67	17	0	-	-	-	-	-	-	67	17	0
Purchase and construction of Mining Models	125	8	7	-	-	-	-	-	-	-	-	-	125	8	7
Outfit and illustration for Lectures	217	0	2	-	-	-	-	-	-	301	9	9	518	9	11
£	7,312	2	1	7,251	7	7	2,287	9	0	5,647	17	5	22,498	16	1

No. 3. Schools throughout the Kingdom in connexion with the Department of Science and Art.

Heads of Service.	Total Expenditure for the Year ending 31st March 1857.		
	£	s.	d.
Salaries for Inspection	2,100	0	0
Aid to Schools by means of Examples	8,070	15	4
Salaries and Aid to Masters, &c.	11,410	6	6
Guarantee Fund and Aid for Instruction	1,600	14	9
Normal Lace School	500	0	0
Prizes and Examinations, &c.	3,255	10	0
Travelling Expenses	1,836	3	7
£	28,773	10	2

Appendix G.

FINANCIAL STATEMENT.

No. 4. GEOLOGICAL SURVEY, Great Britain and Ireland.

Heads of Service.	Total Expenditure for the Year ending 31st March 1857.		
	£	s.	d.
Salaries of Officers, Surveyors, &c. - - -	4,045	4	6
Travelling Expenses - - - - -	1,201	5	6
Incidents and various small Disbursements - -	435	10	10
£	5,682	0	10

No. 5. ROYAL DUBLIN SOCIETY.

Heads of Service.	Total Expenditure for the Year ending 31st March 1857.		
	£	s.	d.
General Objects of the Society - - - -	6,000	0	0
£	6,000	0	0

TOTAL ABSTRACT of the above.

	Total Expenditure for the Year ending 31st March 1857.		
	£	s.	d.
No. 1. General Management - - - -	3,324	12	9½
No. 2. Department of Science and Art - - -	22,498	16	1
No. 3. Schools throughout the Kingdom, in connexion with the Department - - - -	28,773	10	2
No. 4. Geological Survey, Great Britain and Ireland -	5,682	0	10
No. 5. Royal Dublin Society - - - -	6,000	0	0
£	66,278	19	10½

LONDON:
Printed by George E. Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

REPORT

OF THE

METEOROLOGICAL DEPARTMENT

OF

THE BOARD OF TRADE.

1857.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1857.

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REPORT.

My Lord, Board of Trade, March 11, 1857.

In submitting to your Lordship a Report of the state and progress of the Meteorological Department of the Board of Trade, I am enabled to write with rather less hesitation than hitherto, and to look forward with some degree of confidence to satisfactory results.

1. During so short a period as the existence of this office much productiveness could not reasonably be expected, as our time has been engrossed by collecting and preparing materials rather than by publishing them; but we are advancing, and in future shall be able to circulate results periodically.

2. As the subject of Meteorology, and the object of Her Majesty's Government in establishing an office for collecting and discussing observations made at sea, may not be known to many of the persons interested, although familiar to your Lordship, perhaps I may be excused for recapitulating a few points from former papers, before attempting to show the present state and progress of this recently formed department.

3. In the early part of this century, while Mr. Marsden was Secretary of the Admiralty, the want of collected and combined information respecting the ocean was so often felt by that able public servant that he suggested a plan for arranging, or grouping, all that could be obtained in certain convenient divisions of the seas. He then proposed the method of squares as suitable and convenient in practice. (*See* Appendix.)

4. In 1831 a systematic commencement of a collection and discussion of Meteorological observations made at sea was undertaken at the Hydrographical Office of the Admiralty, upon a similar principle; but pressure of other duties, and the limited extent of means then applicable, impeded a continuance of the collection, which was scarcely more than commenced.

5. The twelve large volumes (one for each month) prepared for the Indian ocean, as being less known than the

Atlantic, are now in this office, with their corresponding charts subdivided into numbered squares.

6. This useful arrangement, dividing the ocean into squares, which affords the means of grouping and averaging observations, as well as identifying spaces of sea like provinces of land, was thus originated at the Admiralty.

7. In the year 1838 a system of Meteorological observations on an extensive scale was strenuously advocated by the author of the "Law of Storms" (Sir William Reid), and chiefly in consequence of his arguments officers of the Royal Engineers at detached stations, and Consuls in foreign ports were requested to collect and transmit such observations.*

8. But probably the more immediate object in view at that time was the investigation of storms affecting the safety of ships rather than the duration of their passages; and it was not till Lieutenant Maury, of the United States, fully appreciating what had been previously done in the wide field of research which he was then contemplating, commenced those extensive undertakings, already so useful, which have earned deserved praise for their accumulation of facts, for their useful advice, and valuable results.

9. The maritime commerce of nations having been extended over the world to an unprecedented degree, and competition having reached such a point that the value of cargoes and the profits of enterprise depend more than ever on the duration and nature of voyages, it is obviously a question of the greatest importance to determine the very best tracks for ships to follow in order to make the quickest as well as the safest passages. The employment of steamers in such numbers, the prevalent endeavour to keep as near the *direct* line between two places (the arc of a great circle) as intervening obstacles, currents, and winds allow, and the general improvement in navigation,—cause a demand for more precise and readily available information respecting all frequented parts of the oceans.

10. Not only greater accuracy of detail, but more con-

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* As it has been said that "we want observations in unknown, unfrequented places, rather than in the beaten tracks," it may here be remarked that we require to know all particulars about the most frequented localities, as a first necessity, besides what can be collected about other places generally. Mercantile navigation cannot be too much facilitated by information of the most complete description. The wants of inexperienced persons should be kept in view, not the fleeting acquirements of those who have passed their ordeal.

centration and arrangement of the existing though scattered information (so difficult to obtain speedily), are now required. Besides which instrumental errors have vitiated many results, and have prevented a considerable portion of the Meteorological observations made at sea from being considered better than rough approximations.

11. "It is one of the chief points of a seaman's duty to know where to find a fair wind, and where to fall in with a favourable current;"* but with means hitherto accessible the knowledge of such matters has only been acquired by individuals after years of trial and actual experience at sea; of which the results have not been conveyed adequately to their successors.

12. By the Wind and Current Charts published of late years, chiefly based on the great work of the United States Government, superintended by Lieutenant Maury, and by studying his sailing directions, navigators have been enabled to shorten their passages materially, in many cases as much as one-fourth, in some one-third, of the distance or time previously employed.

13. Although much had been collected and written about winds and currents by well-known authorities, attention had not been sufficiently devoted to the subject, however important to maritime countries, and especially to Great Britain.

14. In 1853, encouraged by the practical results already obtained, the principal maritime Powers authorized qualified persons to assist at a Conference, held at Brussels, on the subject of Meteorology at sea. The Report of that Conference was laid before Parliament, and the result was a vote of money for the purchase of instruments and the discussion of observations, under the superintendence of the Board of Trade.

15. Parliament having voted the necessary expenditure, arrangements were made, in accordance with the views of the Royal Society and the British Association for the Advancement of Science, for a supply of instruments so constructed and tested as to be strictly reliable and intercomparable. A communication was made by Government, in consequence of which the Royal Society obtained the opinions and suggestions of many eminent Meteorologists in Europe and America, and then addressed an elaborate letter to the Board of Trade,† expressing their

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* Basil Hall. † Appendix.

views of the principal objects sought for, and more especially desirable, in the investigations of Meteorological science, with the hope of ascertaining important laws.

16. A naval officer was appointed to execute the duties of this new department (assisted by other persons), and at the beginning of 1855 an office was established at the Board of Trade.

17. Agents were appointed at principal ports, through whom instruments, charts, and books might be furnished to a limited number of very carefully selected ships; and the supply commenced. Since that time more than 200 merchant ships and numerous men-of-war, in which officers have undertaken to make, record, and transmit observations, have been so supplied.

18. Many more ships might have been similarly provided with instruments, had the willingness of their captains alone affected the supply; but as only a certain number of good instruments can be purchased by Government annually, with due regard to the Parliamentary vote of money, and as each of the agents requires a set of instruments to be kept by him for the purpose of comparison with those sent or returned, besides those wanted for comparisons with the barometers at numerous lighthouses, the number must be limited discreetly.

19. Attention to preliminary arrangements, and the preparation of numerous books, forms, and registers, did not prevent an advance towards some practical results, even in the first year. An extensive digest of Maury's Pilot Charts was undertaken, by which their substance is rendered available to the seaman in a graphical instead of a numerical form. These conversions of Maury's wind-roses into diagrams showing his accumulated data in another manner, have been carried on as far as his charts supplied the materials; and from those sources alone have twelve wind charts been compiled and circulated by the Board of Trade, which afford valuable information to the navigator in each of the oceans—(except the South Pacific, from which we are now collecting materials for another chart). The Dutch are following our example, and with improvement, some may think by simplifying the diagrams.

20. These charts are prepared for the four calendar quarters, rather than for the four commonly received seasons of the year, because, in fact, the extreme variations of the atmosphere and of the ocean occur some time after the

equinoxes and solstices, so that February, May, August, and November approximate to the actual extremes nearer than those months which respectively precede them, and are usually considered the middle of each season.

21. This arrangement has been adopted for another reason also, which is, that all parts of the world—all varieties of climate and season—are to be considered, besides those most familiar to Europeans.

22. It is proposed, when sufficient materials are ready, to comprise the contents of such charts as have been described, within the pages of books (preserving the graphical illustration), numbered according to the squares of the world for every month of the year (each square being subdivided where requisite).

23. The effect of such compilations will be, that a person interested in a voyage or distant locality may at once ascertain the average and relative meteorological facts already known about the part of the world in question, including such information about the sea and its currents, as well as the atmosphere over it, as should influence the selection of courses to be steered, or the localities to be visited, therefore immediately affecting the great desideratum of voyagers—a safe and pleasant as well as a speedy passage.

24. It is obvious that by making a passage in less time, there is not only a saving of expense to the merchant, the shipowner, and the insurer, but a great diminution of the risk from fatal maladies,—as instead of losing time, if not lives, in unhealthy localities, heavy rains, or calms with oppressive heat, a ship properly navigated may be speeding on her way under favourable circumstances.

25. Such information, duly classified and rendered easy of access, may become invaluable. At present it exists to a much greater extent than is usually supposed; but being so diffused among a variety of books and documents, it is little better than an unworked mine—unproductive, however rich.

26. In this new office valuable meteorological facts, already collected at the Admiralty, or obtained elsewhere, may be tabulated and discussed, in addition to the continually accruing and more exact data to be furnished in future. A large number of ships are engaged in observations, aided by documents liberally furnished by the United States Government, or by the Board of Trade. Not only has that Government offered directions and

charts *gratis* to American ships, but also to those of other nations, in accordance with easy and just conditions. And in this country the Government, through the Board of Trade, has supplied a certain number of ships going on distant voyages, with charts, meteorological registers, and excellent instruments.

27. Changes in the atmosphere over the ocean, as well as on the land, being intimately connected with electrical or magnetic action, besides wind and weather, all seamen are interested by such matters, while the facts which they register become valuable to philosophers.

28. Meteorological information collected at the Board of Trade is therefore discussed with the twofold object in view—of aiding navigators, or making navigation easier, as well as more certain,—and amassing a collection of accurate and digested observations for the future use of men of science.

29. There is no insuperable reason why every part of the sea should not be known as well as the land; if not, indeed, better, generally speaking, because more accessible and less varied in character. And it is expected that in process of years every frequented square of ocean will have been investigated sufficiently to enable digests to be given, which will afford such guides to the inexperienced as much time and practice only could give them otherwise.

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30. As it is desirable that observations of the wind and barometer should be made and recorded more frequently than those of other kinds, and as every vigilant commander requires them to be made regularly for his information, at least once in each watch, there can be no great additional trouble caused by the Meteorological Log or Register ("Abstract Log," U.S.)—which perhaps may be called the Weather Book.

31. Regular attention to the barometer tends directly to the safety of the ship, as well as the comfort of all on board, and the economy of material; but to make such an inspection of full value the results should be recorded, in order that the movements of the mercurial column may be known during previous days as well as hours. These prolonged comparisons, and judicious inferences drawn from them, afford the means of foretelling wind and weather during the next following period of more or less time, and therefore have an immediately important as well as a future value.

32. Their record, compared subsequently with many other records, will assist the meteorologist in tracing and investigating atmospheric waves and circulating meteors, or cyclones, as well as ordinary gales—subjects by which every seafaring man is vitally interested.

33. A remark has often been made, to the effect that "the barometer was of no use" at a certain place, but such a remark indicated either superficial observation, or that there had been a conflict or concurrence of atmospheric influences or waves at the place in question, which masked, as it were, the coming changes. Such a masking may occur before a great storm, when the barometer is more affected by an *impending* long continuance of particular winds which *follow* the hurricane, than by the *brief*, however violent, storm; *or* when it is kept up by a concurrence of atmospheric waves.

34. The barometric column usually stands, on an average, higher with or before polar and easterly winds than it does with or before equatorial and westerly winds (of equal strength and dryness) in all parts of the world. This average difference ranges from one tenth to six tenths of an inch, according to the local barometric range.

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35. Great improvement has taken place of late years in passages across the ocean, no doubt partly due to the improved construction of ships and eager competition of their owners and captains; but a large share of it must be attributed to publications by which the experience and acquirements of a few persons have been rendered available to many. By collecting and digesting observations already made, but not yet turned to account, and by means of more correct and extensive investigations in future, the "highway of nations" may yearly become more safe, and the intercourse between distant parts of the world remarkably facilitated.

36. To the well-informed and experienced seaman there may be comparatively little to offer; but property and life, to a great extent, must at times be entrusted to inexperienced men. Every commander of a ship must have a beginning.

37. During late years the great increase (by the wider diffusion) of nautical knowledge has not only much shortened sea passages, but has rendered them more secure and less liable to mistakes, as well as to such uncertain delays as occurred so often formerly.

38. The great advantages of making a quick passage are admitted, in a general way, no doubt, but we do not always realize to ourselves the shipowner's, the merchant's, or even the public interest in the question. If a frigate, with important despatches, is some days later in arriving at her destination than might be the case, the possible consequences may be disastrous, but the expense is not thought of because it does not affect individuals, and because the ship is maintained in continuous service for a considerable period, probably some years; but for every day that a merchant ship is delayed beyond the expected or an average time of passage, not only do passengers suffer more or less inconvenience, affecting health, it may be, if not life itself, but the merchant loses and the shipowner loses. The expense of pay, provisions, and wear and tear of a large ship full of cargo and passengers, is from 50*l.* to 100*l.* daily; besides which direct expense, there is the diminution of that ship's annual earnings, by the delay unnecessarily caused before she can commence another voyage. Thus the injurious effects of a long passage are compound, and though well known to the owners of clipper ships are not so clearly recognised by the public at large.

39. It may be, and often has been asked, what inducement has the captain of a ship to make and record meteorological observations, to embarrass himself with extra logs and delicate instruments? To which it may be replied that, irrespective of public acknowledgment, those very instruments, if used at reasonable intervals, become more and more interesting, as well as useful to himself at the time, and for others as well as himself in future.

40. With the assistance of his officers, he has the means of making good observations at least twice a day (probably oftener), as often as at an observatory, and therefore, generally speaking, sufficient, except for a special object or on particular occasions.

41. Undesirable as it undoubtedly is to countenance much less encourage any inaccuracy, a loose mode of observing or recording, or any indifference to minuteness of results, a line must be drawn somewhere, in order that time, attention, and pains may not be wasted, that exertion may not be fruitless, and that active interest may not be checked by a feeling of uncertainty and oppressiveness.

42. Attempts to attain an extreme degree of accuracy, by notations claiming more minute precision than the instruments themselves or even the ultimate exhibitions of results are capable of affording, only perplex and unnecessarily waste valuable time. On land, and in the calculation and discussion of meteorological observations, three places of decimals may be appropriately used, but in observing and recording at sea, two places are sufficient in reading and recording the barometer, and one place of decimals in marking the thermometer.

43. Attempts to ask for more may be inexpedient, and, like a demand for too frequent observations, not unlikely to discourage those who have many other claims on their time and thought. Observers at sea, in bad weather, in war time, or at other critical periods, find risk as well as difficulty in using instruments, their circumstances being so different from those of observers in convenient buildings on land.

44. In consequence of the assistance given by the Kew Committee of the British Association, the instruments offered by Government are not only more correct, but less liable to error, if not injury, than those hitherto used, and they are, generally speaking, *lent* gratuitously, though they may be purchased for a ship at their cost price, and this (considering their tested value) is a great advantage.

45. Those who undertake to keep the registers, or weather books (abstract logs), are supplied with them free of all expense, and they are asked to insert observations *only when taken* at such times among the numerous hours stated as may be most exact. It is not intended, by any means, that all the hours specified should be times of observation for each person, but that every observation carefully made shall be entered at the correct time and place in the book.

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46. The importance of accumulating and discussing observations of wind, weather, climate, currents, temperature and density of sea water, and other matters usually included under the term Meteorology, having been fully recognised by Government in the department thus established in 1855 for the collection and discussion of Meteorological observations made at sea:—

47. In order to secure methodical reduction and tabulation of such observations, so arranged that the

philosopher may use them with confidence and facility, and that the navigator may acquire from them practical information without avoidable delay,—much consideration was given to the system of record adopted, which is now, briefly, the following:—

48. The surface of the globe being supposed to be divided into squares, which are numbered and lettered on maps for reference, numbers showing the principal squares, and letters their subdivisions:—(*See* Appendix.)

49. These separate spaces serve for grouping observations, and their respective centres are as points of particular reference for averages, or mean results, like Observatories.

50. Folio books, agreeing with each other in tabular arrangement, are numbered to correspond with the squares, and are so methodised that every individual entry made from any register or log of uncorrected observations, after being duly reduced, can be recorded in its appropriate table in such a way that it may be used singly or otherwise, and identified or traced at any future time.

51. When averages or means are required, of course these data are equally available; but the general principles of operation are to allow no details to be lost or confused, and to leave no doubt as to the special authority for any fact recorded.

52. At present there are in use about sixty collecting books of tabular forms, called Data Books, appropriated to the following subjects:—namely, Barometer, Thermometer, Hydrometer, Winds, Weather, Currents, Variation, Soundings, Crossings, Passages, Storms, Ice, Shooting Stars and Meteors, Aurora, and Electricity.

53. Entries are made in these tabular forms, as the logs, or meteorological registers are successively examined, the various data being extracted, reduced, and recorded by different persons, and remarkable passages of immediate interest being noted for publication.

54. To the present time about 700 months (equal to 58 years of one log) of good meteorological logs have been received from nearly 100 selected ships in the mercantile navy, and about a third of these registers have been already discussed and tabulated.

55. Before they were received, the 12 wind charts for the principal oceans, already mentioned as converted from those of Maury, were compiled and published.

56. There are now more than 180 merchantmen supplied with tested and reliable instruments, besides charts

and books, of which ships more than 100 have already returned logs.

57. The character of these ships and of their captains may be inferred from the annexed return of registers already received, and from the fact that, in accordance with this return, the following distinguishing marks are now authorized in the Mercantile Navy List by the President of the Board of Trade. (*See* Appendix.)

58. To those names included in the first list the letter A is affixed; to those in the second, B; in the third, C; and in the fourth, D. And in future years the same names may be further distinguished by numbers or additional letters.

59. Moreover, five captains* having sent in meteorological registers, not only superior to others, but exemplary in a high degree, the honorary reward of a valuable telescope is to be presented to each of those gentlemen, by order of the President.

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60. In the Appendix to this Report are statements of the supply and expenditure on account of this department, with the number of instruments injured or become unserviceable out of the whole quantity purchased by Government.

61. Other documents also are appended, to which further reference will be made, especially those relating to the co-operation of Her Majesty's Navy.

62. Hitherto not many meteorological logs have been received from Her Majesty's ships, because the war with Russia caused unavoidable obstacles for a time, and because registers sent to foreign stations in 1855 have not yet been returned. But from some ships excellent documents have been already received, and their contents tabulated, among which the logs of the "Frolic," Captain Nolloth; "Hastings," Captain Caffin; "Impérieuse," Captain Watson (kept by Messrs. Scott† and Grigor‡); "Dauntless," Captain Ryder; "Duke of Wellington," Captain Caldwell, and others, are very praiseworthy.

63. The archives of the Admiralty contain almost inexhaustible mines of certain kinds of meteorological information, though not so valuable as that lately obtained,

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* Boyd, Quirk, Toynbee, Trivett, and Wood.
† Master. ‡ Surgeon.

with the aid of more reliable instruments and better directed observers.

64. To these stores the Admiralty have authorized access, and only the narrow limit of our own number prevents more facts being extracted thence. Much might be culled that would tend to the benefit of navigation.

65. Besides some extracts from these Admiralty records (chiefly the logs of ships lately employed in the Black Sea and Indian Ocean), the Admiralty observations made during late years at Ascension, Bermuda, Halifax, Valparaiso, Trincomalee, Point de Galle, and Columbo, have been discussed and prepared for publication, in a form corresponding to that established in the Corps of Royal Engineers by Colonel James, authorized by Sir John Burgoyne.

66. Perhaps here reference may also be made to a result obtained from the comparison *at sea*, within the tropics, of a great many reliable Kew model barometers.

67. Within certain limits of latitude, near the equator, the barometer varies so little from a normal height now ascertained, that (allowing for its tidal change) any ship *between those parallels* may ascertain the error of her barometer, aneroid, or sympiesometer, to nearly three hundredths of an inch, and this without incurring risk by moving the instrument, and without any trouble, beyond making the usual observations.

68. By this fact, which could only have been proved by employing such instruments as those recommended by the Kew Committee, a value is given to all barometrical observations made by ships crossing the equator, equivalent to that derivable from comparisons with a standard instrument; and as this applies to past as well as to future observations, it will be the more appreciated.

69. Having shown what has been effected to the present time, and having given an outline of *some* future proceedings now contemplated, a reference to the Royal Society's letter, in the Appendix, may be requested as an exposition of the views of that learned body (in 1854) with respect to these subjects.

70. Instructions from the Admiralty are likewise appended, besides examples of various printed forms in use, which, with the copies of a few pages from the data books, serve to show much of the general nature and extent of the duties to be executed. There is a great deal of detail connected with the selection, purchase, charge, and dis-

tribution of instruments, which, however indispensable, interferes exceedingly with the time and thought required for calculations and the deduction of results.

71. At present the rooms allotted to the Meteorological Office are so filled that additional persons would be detrimental. Space is wanted for packing and storing instruments, as well as for keeping records accessibly: but, with more accommodation, and additional assistance, our fast accumulating materials may be overtaken, and their results promptly published.

72. At present the zealous assiduity of the four persons regularly employed does not suffice to keep pace with increasing current work, and therefore much lately recorded information lies untouched, unavoidably, which ought to be made available.

73. The *annual* expenditure on account of this department, authorized by Parliament, has been *3,200l.* for the Board of Trade, with *1,000l.* on account of the Admiralty: and it does not seem necessary to ask for more money, as there is now a stock of good Instruments on hand, but rather that a larger portion of the sums voted might be devoted to the Office, in order that more assistance might be obtained.

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74. The special question, "What results should be periodically published?" demands and has had much consideration. Some persons who take the trouble to keep Meteorological registers say, "Publish them in full." But this would be as impracticable in general as unavailing. The *combined data* from many sources are wanted by the public who are interested in such matters, not isolated diaries or extracts, except in special cases. But what extent or kind of combination is advisable? Some scientific men require original observations, singly or in numbers, still preserving their individuality. Others prefer means or averages for certain periods, say "five-day," monthly, or yearly; and as each has special objects in view, perhaps of equal importance, it appears to be advisable to tabulate all data in such a manner as to be available for the advocates of either method, and on no account to diminish the value of any original observation by recording it (duly corrected or reduced) otherwise than individually. Examples of the methods adopted are given in the Appendix from the data books.

75. At present it is proposed to publish copies of the filled pages of these data books as frequently as may be practicable, and in a form as suitable for transmission by post as can be devised; because the expenses of postage, besides national diversities of language and measures or scales, and the want of full arrangement as to what results or data shall be interchanged, have hitherto much impeded due co-operation.

76. As one illustration of what might be speedily effected by combination, a portion of a plan is submitted in the Appendix, which, if fully executed, would throw a light on the atmospheric changes over the British Islands and their vicinity, which has been unattainable hitherto, though long desired.* I refer to ascertaining the simultaneous states of the atmosphere at certain times (for example, during this last winter), remarkable for their extreme and sudden changes, at very numerous stations on land as well as at sea within an area comprised between the parallels of 40 and 70 degrees north, and the meridians of 10 degrees east longitude and 30 west.

77. For each selected time (referred to one meridian) a chart should be compiled of the atmosphere within these limits: and from such charts a great amount of information, practically as well as scientifically useful, might be derived. Their intercomparison might tend to show the course, progress, and nature of those changes, which now seem so uncertain, and cause so much anxiety to farmers and travellers, as well as to those most interested, who are concerned in navigation or fishery. Scientific men would obtain facts immediately applicable to theories of wind and weather, and to a more distinct elucidation of the nature and progress of atmospheric waves. The meteorological history of three months of winter, and perhaps three of summer, by such a combination, would be the object aimed at if approved.

78. When Sir John Herschel proposed "term days" for general use in the great combination of magnetical and meteorological observers, which was instituted in 1838, that great philosopher recommended united efforts to be made at *definite limited times*. (Those meteorological observations being for purely scientific objects

* Besides nearly one hundred places of regular observation within the British Islands, registers are kept at the lighthouses—now very numerous.

rather than for those of navigation, however related to them, were not specially referred to at the commencement of this report.) The principle of observing at certain terms rather than constantly, if adopted generally, might induce many persons to co-operate who now cannot undertake to observe continuously,—besides being otherwise advantageous.

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79. While Great Britain has been taking part in the system of international co-operation arranged at Brussels, it is natural to inquire what is in progress among other nations?

80. In the United States the Superintendent of the National Observatory, the celebrated Maury, has continued his labours indefatigably, as evidenced by new charts, valued books, and useful correspondence. In Holland the Meteorological Institute has published three volumes of nautical information, extracted from Dutch logs in the Indian seas as well as the Atlantic Ocean. In those volumes is also given a conversion of Maury's Pilot charts, reduced to a small scale, for every month, on a plan analogous to that of the Board of Trade. And at the Mauritius a volume has been published which is valuable for the Indian Ocean, especially to seamen. The materials for it were commenced by the zealous and much lamented meteorologist, Dr. Thom.

81. In the United States, the Medical Department of the Army takes charge of Meteorology on land, where their stations are numerous and widely scattered. In their Navy the captains are responsible (as in our own service), but one may express a hope, perhaps, that medical officers at sea may be willingly enlisted among efficient co-operators, if encouraged by the Authorities.

82. Unless some person is specially interested in the subject on board each ship, one cannot expect due consistency of observation, or such a degree of correctness as might be ensured by one person's even occasional supervision, in *addition* to that of the captain, who on board a ship of war has the superintendence of every thing, in a *general* way.

83. In conclusion I would say, that besides reporting briefly on the progress, the present state, and the require-

ments of the Meteorological Department, my object has been to give such an account of its origin and duties, as may serve for a record, and as a document to be referred to, in shaping future proceedings.*

I have the honour to be,
Your Lordship's obedient Servant,
ROBERT FITZROY.

The Lord Stanley of Alderley,
President of the Board of Trade.

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* The Parliamentary Papers connected with Meteorological Observations at Sea were presented in February 1853 (No. 115) and in February 1854, the latter containing a Report of the Brussels Conference.

APPENDIX.

APPENDIX A.

Letter from the Royal Society.

Reply of the President and Council of the Royal Society to a Letter from the Board of Trade, dated January 15, 1854.

Royal Society, Somerset House,
February 22, 1855.

Sir,

In the month of June last, the Lords of the Committee of the Privy Council for Trade caused a letter to be addressed to the President and Council of the Royal Society, acquainting them that their Lordships were about to submit to Parliament an estimate for an office for the discussion of the observations on Meteorology to be made at sea in all parts of the globe, in conformity with the recommendation of a conference held at Brussels in 1853; and that they were about to construct a set of forms for the use of that office, in which they proposed to publish from time to time and to circulate such statistical results, obtained by means of the observations referred to, as might be considered most desirable by men learned in the science of Meteorology, in addition to such other information as might be required for the purposes of navigation.

Before doing so, however, their Lordships were desirous of having the opinion of the Royal Society, as to what were the great desiderata in meteorological science; and as to the forms which may be best calculated to exhibit the great atmospheric laws which it may be most desirable to develop.

Their Lordships further state, that as it may possibly happen that observations on land upon an extended scale may hereafter be made and discussed in the same office, it is desirable that the reply of the Royal Society should keep in view, and provide for, such a contingency.

Deeply impressed with a sense of the magnitude and importance of the work which has been thus undertaken by Her Majesty's Government, and confided to the Board of Trade, and fully appreciating the honour of being consulted, and the responsibility of the reply which they are called upon to make;—considering also that by including the contingency of *land* obser-

vations, the inquiry is, in fact, co-extensive with the requirements of meteorology over all accessible parts of the earth's surface,—the President and Council of the Royal Society deemed it advisable, before making their reply, to obtain the opinion of those amongst their foreign members who are known as distinguished cultivators of meteorological science, as well as of others in foreign countries, who either hold offices connected with the advancement of Meteorology, or have otherwise devoted themselves to this branch of science.

A circular was accordingly addressed to several gentlemen whose names were transmitted to the Board of Trade in June last, containing a copy of the communication from the Board of Trade, and a request to be favoured with any suggestions which might aid Her Majesty's Government in an undertaking which was obviously one of general concernment.

Replies in some degree of detail have been received from five of these gentlemen,* copies of which are herewith transmitted.

The President and Council are glad to avail themselves of this opportunity of expressing their acknowledgments to these gentlemen, and more particularly to Professor Dové, Director of the meteorological establishments and institutions in Prussia, whose zeal for the advancement of meteorology induced him to repair personally to England, and to join himself to the Committee by whom the present reply has been prepared. Those who are most familiar with the labours and writings of this eminent meteorologist will best be able to appreciate the value of his co-operation.

The President and Council have considered it as the most convenient course to divide their reply under the different heads into which the subject naturally branches. But before they proceed to treat of these, they wish to remark generally, that one of the chief impediments to the advancement of meteorology consists in the very slow progress which is made in the transmission from one country to another of the observations and discussions on which, under the fostering aid of different governments, so much labour is bestowed in Europe and America: and they would therefore recommend that such steps as may appear desirable should be taken by Her Majesty's Government to promote and facilitate the mutual interchange of meteorological publications emanating from the governments of different countries.

Barometer.

It is known that considerable differences, apparently of a permanent character, are found to exist in the mean barometric pressure in different places: and that the periodical variations in the pressure in different months and seasons at the same place are very different in different parts of the globe, both as respects period and amount; insomuch that in extreme cases, the variations have even opposite features in regard to period, in places

* Dr. Erman of Berlin; Dr. Heis of Münster; Prof. Kreil of Vienna; Lieut. Maury of Washington; and M. Quetelet of Brussels.

situated in the same hemisphere and at equal distances from the equator.

For the purpose of extending our knowledge of the facts of these departures from the state of equilibrium, and of more fully investigating the causes thereof, it is desirable to obtain, by means of barometric observations strictly comparable with each other, and extending over all parts of the globe accessible by land or sea, *tables*, showing the mean barometric pressure *in the year*, *in each month of the year*, and *in the four meteorological seasons*, —on land, at all stations of observation,—and at sea, corresponding to the middle points of spaces bounded by geographical latitudes and longitudes, not far distant from each other.

The manner of forming such tables from the marine observations which are now proposed to be made, by collecting together observations of the same month in separate ledgers, each of which should correspond to a *geographical space* comprised between specified meridians and parallels, and to a *particular month*, is too obvious to require to be further dwelt upon. The distances apart of the meridians and parallels will require to be varied in different parts of the globe, so that the magnitudes of the spaces which they enclose, and for each of which a table will be formed, may be more circumscribed, when the rapidity of the variation of the particular phenomena to be elucidated is greatest in regard to geographical space. Their magnitude will also necessarily vary with the number of observations which it may be possible to collect in each space, inasmuch as it is well known that there are extensive portions of the ocean which are scarcely ever traversed by ships, whilst other portions may be viewed as the highways of a constant traffic.

The strict comparability of observations made in different ships may perhaps be best assured, by limiting the examination of the instruments to comparisons which it is proposed to make at the Kew Observatory, before and after their employment in particular ships. From the nature of their construction, the barometers with which Her Majesty's navy and the mercantile marine are to be supplied are not very liable to derangement, except from such accidents as would destroy them altogether. Under present arrangements they will all be carefully compared at Kew before they are sent to the Admiralty or to the Board of Trade ; and similar arrangements may easily be made by which they may be returned to Kew for re-examination at the expiration of each tour of service. The comparison of barometers, when embarked and in use, with standards, or supposed standards, at ports which the vessels may visit, entails many inconveniences, and is in many respects a far less satisfactory method. The limitation here recommended is not, however, to be understood as applicable in the case of other establishments than Kew, where a special provision may be made for an equally careful and correct examination.

At land stations, in addition to proper measures to assure the correctness of the barometer and consequent comparability of the

observations, care should be taken to ascertain by the best possible means (independently of the barometer itself) the height of the station above the level of the sea at some stated locality. For this purpose the extension of levels for the construction of railroads will often afford facilities.

It may be desirable to indicate some of the localities where the data, which tables such as those which have been spoken of would exhibit, are required for the solution of problems of immediate interest.

1°. It is known, that over the Atlantic Ocean a low mean annual pressure exists near the equator, and a high pressure at the north and south borders of the torrid zone (23° to 30° north and south latitudes); and it is probable that from similar causes similar phenomena exist over the corresponding latitudes in the Pacific Ocean: the few observations which we possess are in accord with this supposition; but the extent of space covered by the Pacific is large and the observations are few; they may be expected to be greatly increased by the means now contemplated. But it is particularly over the Indian Ocean, both at the equator and at the borders of the torrid zone, that the phenomena of the barometric pressure, not only annual but also monthly, require elucidation by observations. The trade winds, which would prevail generally round the globe if it were wholly covered by a surface of water, are interrupted by the large continental spaces in Asia and Australia, and give place to the phenomena of monsoons, which are the indirect results of the heating action of the sun's rays on those continental spaces. These are the causes of that displacement of the trade-winds, and substitution of a current flowing in another direction, which occasion the atmospheric phenomena over the Indian Ocean, and on the north and south sides of that ocean, to be different from those in corresponding localities over and on either side of the equator in the Atlantic Ocean, and (probably generally also) in the Pacific Ocean.

It is important alike to navigation and to general science to know the limits where the phenomena of the trade winds give place to those of the monsoons; and whether any and what variations take place in those limits in different parts of the year. *The barometric variations are intimately connected with the causes of these variations, and require to be known for their more perfect elucidation.*

The importance, indeed, of a full and complete knowledge of the variations which take place in the limits of the trade winds, generally in both hemispheres, at different seasons of the year, has long been recognised. On this account, although the present section is headed "Barometer," it may be well to remark here, that it is desirable that the forms supplied to ships should contain headings, calling forth a special record of the latitude and longitude where the trade wind is first met with, and where it is first found to fail.

2°. The great extent of continental space in Northern Asia causes, by reason of the great heat of the summer and the ascend-

ing current produced thereby, a remarkable diminution of atmospheric pressure in the summer months, extending in the north to the Polar Sea, and on the European side as far as Moscow. Towards the east it is known to include the coast of China and Japan, but the extent of this great diminution of summer pressure beyond the coasts thus named is not known. A determination of the monthly variation of the pressure over the adjacent parts of the Pacific Ocean is therefore a desideratum; and for the same object it is desirable to have a more accurate knowledge than we now possess of the prevailing direction of the wind in different seasons in the vicinity of the coasts of China and Japan.

3°. With reference to regions or districts of increased or diminished *mean annual* pressure, it is known that in certain districts in the temperate and polar zones, such as in the vicinity of Cape Horn extending into the antarctic polar ocean, and in the vicinity of Iceland, the mean anuual barometric pressure is *considerably* less than the average pressure on the surface of the globe generally; and that anomalous differences, also of considerable amount, exist in the mean pressure in different parts of the arctic ocean. These all require special attention, with a view to obtain a more perfect knowledge of the facts, in regard to their amount, geographical extension, and variation with the change of seasons, as well as to the elucidation of their causes.

Dry Air and Aqueous Vapour.

The apparently anomalous variations which have been noticed to exist in the mean annual barometric pressure, and in its distribution in the different seasons and months of the year, are also found to exist in each of the two constituent pressures which conjointly constitute the barometric pressure. In order to study the problems connected with these departures from a state of equilibrium under their most simple forms,—and generally for the true understanding of almost all the great laws of atmospheric change,—it is necessary to have a separate knowledge of the two constituents (viz., the pressures of the dry air and of the aqueous vapour) which we are accustomed to measure together by the barometer. This separate knowledge is obtained by means of the hygrometer, which determines the elasticity of the vapour, and leads to the determination of that of the dry air, by enabling us to deduct the elasticity of the vapour from that of the whole barometric pressure. It is therefore extremely desirable that tables, similar to those recommended under the preceding head of the barometer, should be formed at every land station, and over the ocean at the centres of geographical spaces bounded by certain values of latitude and longitude, for the *annual*, *monthly*, and *season* pressures,—1. Of the aqueous vapour; and 2. Of the dry air; each considered separately. Each of the said geographical spaces will require its appropriate ledger for each of the twelve months.

It may be desirable to notice one or two of the problems connected with extensive and important atmospherical laws, which may be materially assisted by such tables.

1°. By the operation of causes which are too well known to require explanation here, the dry air should always have a minimum pressure in the hottest months of the year. But we know that there are places where the contrary prevails, namely, that the pressure of the dry air is greater in summer than in winter. We also know that when comparison is made between places in the same latitude, and having the same, or very nearly the same, differences of temperature in summer and in winter, the differences between the summer and winter pressures of the dry air are found to be subject to many remarkable anomalies. The variations in the pressure of the dry air do not therefore, as might be at first imagined, depend altogether on the differences between the summer and winter temperatures at the places where the variations themselves occur. The increased pressure in the hottest months appears rather to point to the existence of an overflow of air in the higher regions of the atmosphere from *lateral sources;* the statical pressure at the base of the column being increased by the augmentation of the superincumbent mass of air arising from an influx in the upper portion. Such lateral sources may well be supposed to be due to *excessive ascensional currents* caused by *excessive summer heats* in certain places of the globe (as, for example, in Central Asia). Now the lateral overflow from such sources, traversing in the shape of currents the higher regions of the atmosphere, and encountering the well-known general current flowing from the equator towards the pole, has been recently assigned with considerable probability (derived from its correspondence with many otherwise anomalous phenomena already known, and which all receive an explanation from such supposition) to be the original source or primary cause of the *rotating storms* or *cyclones*, so well known in the West Indies and in China under the names of hurricanes and typhoons. A single illustration may be desirable. Let it be supposed that such an excessive ascensional current exists over the greatly heated parts of Asia and Africa in the northern tropical zone,—giving rise, in the continuation of the same zone over the Atlantic Ocean, to a lateral current in the upper regions ; this would then be a current prevailing in those regions from east to west; and it would encounter over the Atlantic Ocean the well-known upper current proceeding from the equator towards the pole, which is a current from the south-west. An easterly current impinging on a south-west current may give rise, by well-known laws, to a rotatory motion in the atmosphere, of which the direction may be the same as that which characterizes the cyclones of the northern hemisphere. To test the accurrcy of this explanation, we desire to be acquainted with the variations which the *mean pressure of the dry air undergoes in the different seasons* in the part of the globe where, according to this explanation, considerable variations having particular characters ought to be found.

2°. We have named one of the explanations which have been recently offered of the primary cause of the northern cyclones. Another mode of explanation has been proposed, by assuming the condensation of large quantities of vapour, and the consequent influx of air to supply the place. In such case the phenomena are to be tested in considerable measure by the variations which the *other constituent* of the barometric pressure, namely, the *aqueous vapour* undergoes.

3°. The surface of sea in the southern hemisphere *much* exceeds that in the northern hemisphere. It is therefore probable that at the season when the sun is over the southern hemisphere, evaporation over the whole surface of the globe is more considerable than in the opposite season, when the sun is over the northern hemisphere. Supposing the pressure of the dry air to be a constant, the difference of evaporation in the two seasons may thus produce for the whole globe an *annual barometric variation*, the aggregate barometric pressure over the *whole* surface being highest during the northern winter. The separation of the barometric pressure into its two constituent pressures would give direct and conclusive evidence of the cause to which such a barometric variation should be ascribed. It would also follow that evaporation being greatest in the south, and condensation greatest in the north, the water which proceeds from south to north in a state of vapour would have to return to the south in a liquid state, and might possibly exert some discernible influence on the currents of the ocean. The tests by which the truth of the suppositions thus advanced may be determined are the variations of the meteorological elements in different seasons and months, determined by methods and instruments strictly comparable with each other, and arranged in such tables as have been suggested. A still more direct test would indeed be furnished by the fact (if it could be ascertained), that the quantity of rain which falls in the northern is greater than that which falls in the southern hemisphere, and by examining its distribution into the different months and seasons of its occurrence. Data for such conclusions are as yet very insufficient; they should always, however, form a part of the record at all land stations where registers are kept.

In order that all observations of the elasticity of the aqueous vapour may be strictly comparable, it is desirable that all should be computed by the same tables; those founded upon the experiments of MM. Regnault and Magnus may be most suitably recommended for this purpose, not only on their general merits, but also as being likely to be most generally adopted by observers in other countries.

Temperature of the Air.

Tables of the mean temperature of the air in the year, and in the different months and seasons of the year, at above 1,000 stations on the globe, have recently been computed by Professor Dove, and published under the auspices of the Royal Academy of

Sciences at Berlin. This work, which is a true model of the method in which a great body of metereological facts, collected by different observers and at different times, should be brought together and co-ordinated, has conducted, as is well known, to conclusions of very considerable importance on their bearing on climatology, and on the general laws of the distribution of heat on the surface of the globe. These tables have, however, been formed exclusively from observations made *on land*. For the completion of this great work of physical geography, there is yet wanting a similar investigation for the *oceanic* portion: and this we may hopefully anticipate as likely to be now accomplished by means of the marine observations about to be undertaken. In the case of the temperature of the air, as in that of the atmospheric pressure previously adverted to, the centres of geographical spaces bounded by certain latitudes and longitudes will form points of concentration for observations which may be made within those spaces, not only by the same but also by different ships; provided that the system be steadily maintained of employing only instruments which shall have been examined, and their intercomparability ascertained, by a competent and responsible authority; and provided that no observations be used but those in which careful attention shall have been given to the precautions which it will be necessary to adopt, for the purpose of obtaining the correct knowledge of the temperature of the external air, amidst the many disturbing influences from heat and moisture so difficult to escape on board ship. In this respect additional precautions must be used, if *night observations* are to be required, since the ordinary difficulties are necessarily much enhanced by the employment of artificial light. Amongst the instructions which will be required perhaps there will be none which will need to be more carefully drawn than those for obtaining the correct temperature of the external air under the continually varying circumstances that present themselves on board ship.

In regard to *land stations* Professor Dove's tables have shown that data are still pressingly required from the British North American possessions intermediate between the stations of the Arctic Expeditions and those of the United States; and that the deficiency extends across the whole North American Continent in those latitudes from the Atlantic to the Pacific. Professor Dove has also indicated as desiderata observations at the British Military stations in the Mediterranean (Gibraltar, Malta, and Corfu), and around the Coasts of Australia and New Zealand: also that *hourly* observations, continued for at least one year, are particularly required at some one station in the West Indies, to supply the diurnal corrections for existing observations.

Whilst the study of the distribution of heat at the surface of the globe has thus been making progress, in respect to the *mean annual temperature* in different places, and to its *periodical variations* in different parts of the year at the same place, the attention of physical geographers has recently been directed (and

with great promise of important results to the material interests of men as well as to general science) to the causes of those fluctuations in the temperature, or departures from its mean or normal state at the same place and at the same period of the year, which have received the name of "non-periodic variations." It is known that these frequently affect extensive portions of the globe at the same time; and are generally, if not always, accompanied by a fluctuation of an opposite character, prevailing at the same time in some adjoining but distant region; so that by the comparison of synchronous observations a progression is traceable, from a locality of maximum increased heat in one region, to one of maximum diminished heat in another region. For the elucidation of the non-periodic variations even *monthly* means are insufficient; and the necessity has been felt of computing the mean temperatures for periods of much shorter duration. The Meteorological Institutions of those of the European States which have taken the foremost part in the prosecution of meteorology, have in consequence adopted *five-day means*, as the most suitable intermediate gradation between daily and monthly means; and as an evidence of the conviction which is entertained of the value of the conclusions to which this investigation is likely to lead, it has been considered worth while to undertake the prodigious labour of calculating the five-day means of the most reliable existing observations during a century past. This work is already far advanced; and it cannot be too strongly recommended, that at all fixed stations, where observations shall hereafter be made with sufficient care to be worth recording, five-days means may invariably be added to the daily, monthly, and annual means into which the observations are usually collected. The five-day means should always commence with January 1, for the purpose of preserving the uniformity at different stations, which is essential for comparison: in leap years, the period which includes the 29th of February will be of six days.

In treating climatology as a *science*, it is desirable that some correct and convenient mode should be adopted for computing and expressing the *comparative variability* to which the temperature in different parts of the globe, and in different parts of the year in the same place, is subject from non-periodic causes. The *probable variability*, computed on the same principle as the *probable error* of each of a number of independent observations, has recently been suggested as furnishing an index "of the probable daily non-periodic variation" at the different seasons of the year; and its use in this respect has been exemplified by calculations of the "index" from the five-day means of twelve years of observations at Toronto, in Canada (Phil. Trans. 1853, Art V.) An index of this description is of course of absolute and general application; supplying the means of comparing the probable variability of the temperature in different seasons at *different places* (where the same method of computation is adopted) as well as at the *same place*. It is desirable that this (or some

preferable method, if such can be devised for obtaining the same object) should be adopted by those who may desire to make their observations practically useful for sanitary or agricultural purposes, or for any of the great variety of objects for which climatic peculiarities are required to be known. Having these three data, viz., the mean annual temperature,—its periodical changes in respect to days, months, and seasons,—and the measure of its liability to non-periodic (or what would commonly be called irregular) variations,—we may consider that we possess as complete a representation of the climate of any particular place (so far as temperature is concerned) as the present state of our knowledge permits.

It is obvious that much of what has been said under this Article is more applicable to land than to sea observations; but the letter of the Board of Trade, to which this is a reply, requests that both should be contemplated.

Temperature of the Sea, and Investigations regarding Currents.

It is unnecessary to dwell on the practical importance to *navigation* of a correct knowledge of the currents of the ocean; their direction, extent, velocity, and the temperature of the surface water relatively to the ordinary ocean temperature in the same latitude; together with the variations in all these respects which currents experience in different parts of the year, and in different parts of their course. As the information on these points, which may be expected to follow from the measures adopted by the Board of Trade, must necessarily depend in great degree on the *intelligence*, as well as the *interest* taken in them by the observers, it is desirable that the instructions to be supplied with the meteorological instruments should contain a brief summary of what is already known in regard to the principal oceanic currents; accompanied by charts on which their supposed limits in different seasons, and the variations in those limits which may have been observed in particular years, may be indicated, with notices of the particularities of the temperature of the surface-water by which the presence of the current may be recognised. Forms will also be required for use in such localities, in which the surface temperatures may be recorded at hourly or half-hourly intervals, with the corresponding geographical positions of the ship, as they may be best inferred from observation and reckoning. For such localities also it will be necessary that the tables, into which the observations of different ships at different seasons are collected, should have their bounding lines of latitude and longitude brought nearer together than may be required for the ocean at large.

In looking forward to the results which are likely to be obtained by the contemplated marine observations, it is reasonable that those which may bear practically on the interests of navigation should occupy the first place; but, on the other hand, it

would not be easy to over-estimate the advantages to physical geography, of general tables of the surface temperature of the ocean in the different months of the year, exhibiting, as they would do, its normal and its abnormal states, the mean temperature of the different parallels, and the deviations therefrom, whether permanent, periodical, or occasional. The knowledge which such tables would convey is essentially required for the study of climatology *as a science.*

The degree in which climatic variations extending over large portions of the earth's service may be influenced by the variable phenomena of oceanic currents in different years, may perhaps be illustrated by circumstances of known occurrence in the vicinity of our own coasts. The admirable researches of Major Rennell have shown that in ordinary years the warm water of the great current known by the name of the Gulf-stream is not found to the east of the meridian of the Azores; the sea being of ordinary ocean temperature for its latitude at all seasons, and in every direction, in the great space comprised between the Azores and the coasts of Europe and North Africa: but Major Rennell has also shown that on two occasions, viz., in 1776 and in 1821–1822, the warm water by which the Gulf-stream is characterised throughout its whole course (*being several degrees* above the ordinary ocean temperature in the same latitude), was found to extend across this great expanse of ocean, and in 1776 (in particular) was traced (by Dr. Franklin) quite home to the coast of Europe. The presence of a body of unusually heated water, extending for several hundred miles both in latitude and in longitude, and continuing for several weeks, at a season of the year when the prevailing winds blow from that quarter on the coasts of England and France, can scarcely be imagined to be without a considerable influence on the relations of temperature and moisture in those countries. In accordance with this supposition, we find in the Meteorological Journals of the more recent period (which are more easily accessible). that the state of the weather in November and December 1821 and January 1822 was so unusual in the southern parts of Great Britain and in France, as to have excited general observation; we find it characterised as "most extraordinarily hot, damp, stormy, and oppressive," that "the gales from the W. and S.W. were almost without intermission," "the fall of rain was excessive," and "the barometer lower than it had ever been known for 35 years before."

There can be little doubt that Major Rennell was right in ascribing the unusual extension of the Gulf-stream in particular years to its greater initial velocity, occasioned by a more than ordinary difference in the levels of the Gulf of Mexico and of the Atlantic in the preceding summer. An unusual height of the Gulf of Mexico at the head of the stream, or an unusual velocity of the stream at its outset in the Strait of Florida, are facts which may admit of being recognised by properly directed attention; and as these must precede, by many weeks, the arrival of the

warm water of the stream at above 3,000 miles distant from its outset, and the climatic effects thence resulting, it might be possible to anticipate the occurrence of such unusual seasons upon our coasts.

Much, indeed, may undoubtedly be done towards the increase of our partial acquaintance with the phenomena of the Gulf-stream, and of its counter currents, by the collection and co-ordination of observations made by casual passages of ships in different years and different seasons across different parts of its course; but for that full and complete knowledge of all its particulars, which should meet the maritime and scientific requirements of the period in which we live, we must await the disposition of Government to accede to the recommendation, so frequently made to them by the most eminent hydrographical authorities, of a specific survey of the stream by vessels employed for that special service. What has been recently accomplished by the Government of the United States in this respect shows both the importance of the inquiry and the great extent of the research, and lends great weight to the proposition which has been made to to Her Majesty's Government on the part of the United States, for a joint survey of the whole stream by vessels of the two countries. The establishment of an office under the Board of Trade specially charged with the reduction and co-ordination of such data may materially facilitate such an undertaking.

Storms or Gales.

It is much to be desired, both for the purposes of navigation and for those of general science, that the captains of Her Majesty's ships and masters of merchant vessels should be correctly and thoroughly instructed in the methods of distinguishing *in all cases* between the rotatory storms or gales, which are properly called *Cyclones*, and gales of a more ordinary character, but which are frequently accompanied by a veering of the wind, which under certain circumstances might easily be confounded with the phenomena of Cyclones, though due to a very different cause. It is recommended, therefore, that the instructions proposed to be given to ships supplied with meteorological instruments should contain clear and simple directions for distinguishing *in all cases*, and *under all circumstances* between these two kinds of storms; and that the forms to be issued for recording the meteorological phenomena during great atmospheric disturbances should comprehend a notice of all the particulars which are required for forming a correct judgment in this respect.

Thunder-storms.

It is known that in the high latitudes of the northern and southern hemispheres thunder-storms are almost wholly unknown; and it is believed that they are of very rare occurrence over the

ocean in the middle latitudes when distant from continents. By a suitable classification and arrangement of the documents which will be henceforward received by the Board of Trade, statistical tables may in process of time be formed, showing the comparative frequency of these phenomena in different parts of the ocean and in different months of the year.

It is known that there are localities on the globe where, during certain months of the year, thunder-storms may be considered as a periodical phenomenon of daily occurrence. In the Port Royal Mountains in Jamaica, for example, thunder-storms are said to take place *daily* about the hour of noon from the middle of November to the middle of April. It is much to be desired that a full and precise account of such thunder-storms, and of the circumstances in which they appear to originate, should be obtained.

In recording the phenomena of thunder and lightning, it is desirable to state the duration of the interval between the flashes of lightning and the thunder which follows. This may be done by means of a seconds-hand watch, by which the time of the apparition of the flash, and of the commencement (and of the conclusion also) of the thunder may be noted. The interval between the flash and the commencement of the thunder has been known to vary in different cases, from less than a single second to between 40 and 50 seconds, and even on very rare occasions to exceed 50 seconds. The two forms of ordinary lightning, viz., zigzag (or forked) lightning and sheet lightning, should always be distinguished apart; and particular attention should be given both to the observation and to the record, in the rare cases when zigzag lightning either bifurcates, or returns upwards. A special notice should not fail to be made when thunder and lightning, or either separately, occur in a perfectly cloudless sky. When globular lightning (balls of fire) are seen, a particular record should be made of all the attendant circumstances. These phenomena are known to be of the nature of lightning, from the injury they have occasioned in ships and buildings that have been struck by them; but they differ from ordinary lightning not only by their globular shape, but by the length of time they continue visible, and by their slow motion. They are said to occur sometimes without the usual accompaniments of a storm, and even with a perfectly serene sky. Conductors are now so universally employed in ships that it may seem almost superfluous to remark that should a ship be struck by lightning, the most circumstantial account will be desirable of the course which the lightning took, and of the injuries it occasioned; or to remind the seaman that it is always prudent, after such an accident has befallen a ship, to distrust her compasses until it has been ascertained that their direction has not been altered. Accidents occurring *on land* from lightning will, of course receive the fullest attention from meteorologists who may be within convenient distance of the spot.

Auroras and Falling Stars.

Auroras are of such rare occurrence in seas frequented by ships engaged in commerce, that it may seem superfluous to give any particular directions for their observation *at sea;* and land observatories are already abundantly furnished with such. It is, of course, desirable that the meteorological reports received from ships should always contain a notice of the time and place where Auroras may be seen, and of any remarkable features that may attract attention.

The letter from Professor Heis, which is one of the foreign communications annexed, indicates the principal points to be attended to in the instructions which it may be desirable to draw up for the observation of "Falling Stars." For directions concerning Halos and Parhelia, a paper by Monsieur Bravais in the 'Annuaire Météorologique de la France' for 1851, contains suggestions which will be found of much value.

Charts of the Magnetic Variation.

Although the variation of the compass does not belong in strictness to the domain of meteorology, it has been included, with great propriety, amongst the subjects treated of by the Brussels Conference, and should not therefore be omitted here. It is scarcely necessary to remark, that whatever may have been the practice in times past, when the phenomena of the earth's magnetism were less understood than at present, it should in future be regarded as indispensable, that variation-charts should always be constructed for a *particular epoch* and that *all parts* of the chart should show *the variation corresponding to the epoch for which it is constructed.* Such charts should also have, either engraved on the face or attached in some convenient manner, a table, showing the approximate annual rate of the secular change of the variation in the different latitudes and longitudes comprised: so that by means of this table, the variation taken from the chart for any particular latitude and longitude may be corrected to the year for which it is required, if that should happen to be different from the epoch for which the chart is constructed.

A valuable service would be rendered to this very important branch of hydrography if, under the authority of the new department of the Board of Trade, variation-charts for the North and South Atlantic Oceans, for the North and South Pacific Oceans, for the Indian Ocean, and for any other localities in which the requirements of navigation might call for them, were published at *stated intervals*, corrected for the secular change that had taken place since the preceding publication. Materials would be furnished for this purpose by the observations which are now intended to be made, supposing them to be collected and suitably arranged with proper references to date and to geographical position, and to the original reports in which the results and the data on which they were founded were communicated. By

means of these observations the tables of approximate correction for secular change might also be altered from time to time as occasion should require, since the rate of secular change itself is not constant.

All observed variations, communicated or employed as data upon which variation-charts may be either constructed or corrected, should be accompanied by other observational data (the nature of which ought now to be well understood) for correcting the observed variation for the error of the compass occasioned by the ship's iron. It is also strongly recommended that no observations be received as data for the formation or correction of variation-charts, but such as are accompanied by a detailed statement of the principal elements both of observation and of calculation. Proper forms should be supplied for this purpose; or, what is still better, books of blank forms may be supplied, in which the observations themselves may be entered, and the calculation performed by which the results are obtained. Such books of blank forms would be found extremely useful both for the variation of the needle, and for the chronometrical longitude (as well as for lunar observations, if the practice of lunar observations be not, as there is too much reason to fear it is, almost wholly discontinued). By preparing and issuing books of blank forms suitable for these purposes, and by requesting their return in accompaniment with the other reports to be transmitted to the Board of Trade at the conclusion of a voyage, the groundwork would be laid for the attainment of greatly improved habits of accuracy in practical navigation in the British mercantile marine.

The President and Council are aware that they have not exhausted the subject of this reply in what they have thus directed me to address to you; but they think that perhaps they have noticed as many points as may be desirable for *present* attention; and they desire me to add, that they will be at all times ready to resume the consideration if required, and to supply any further suggestions which may appear likely to be useful.

I have the honour to be, Sir,
Your obedient Servant,
W. Sharpey, *Sec.*

To the Secretary of the Lords of the Committee of Privy Council for Trade.

A subsequent correspondence passed, in May and June 1856, from which the following extract may be here given, being the only part of that correspondence which related to the meteorological desiderata referred to in the communication from the Board of Trade.

Extract.

"It cannot be doubted that one of the most important objects of the Meteorological Department, both in a practical and a theoretical view

is the procurement of the statistics of the direction and force of the wind in different seasons of the year over those parts of the Atlantic Ocean which are most usually traversed by ships. The records kept by the vessels themselves, suitably co-ordinated, may be expected in the course of time to do much towards this very important purpose; but the Committee are desirous of bringing under the consideration of the Board of Trade the advisability of aiding and expediting the inquiry by establishing, as far as may be found convenient, self-recording anemometrical instruments on some of the islands of the Atlantic. Detached observations of the wind, taken at intervals on board ship, may be most valuable in filling up the spaces between fixed and unerring self-recording instruments, but are scarcely sufficient to procure such exact knowledge of the variations as is required not less for the purposes and improvement of navigation than for the complete theory of the laws which regulate these variations. The Azores, Madeira, Bermuda, Ascension, and St. Helena are all stations where continuous and exact anemometrical records might be obtained, probably with very little inconvenience and at a comparatively small cost, and would be most valuable in the relation above stated. A self-recording anemometer quite suitable for this purpose is now under construction at the Kew Observatory; and instruments on the same model might be procured complete, it is believed, at a cost of less than 50*l*., requiring no other alteration than the change, once in twenty-four hours, of the paper on which the instrument itself records the direction and force of the wind."

DIAGRAMS.

SQUARE 375.

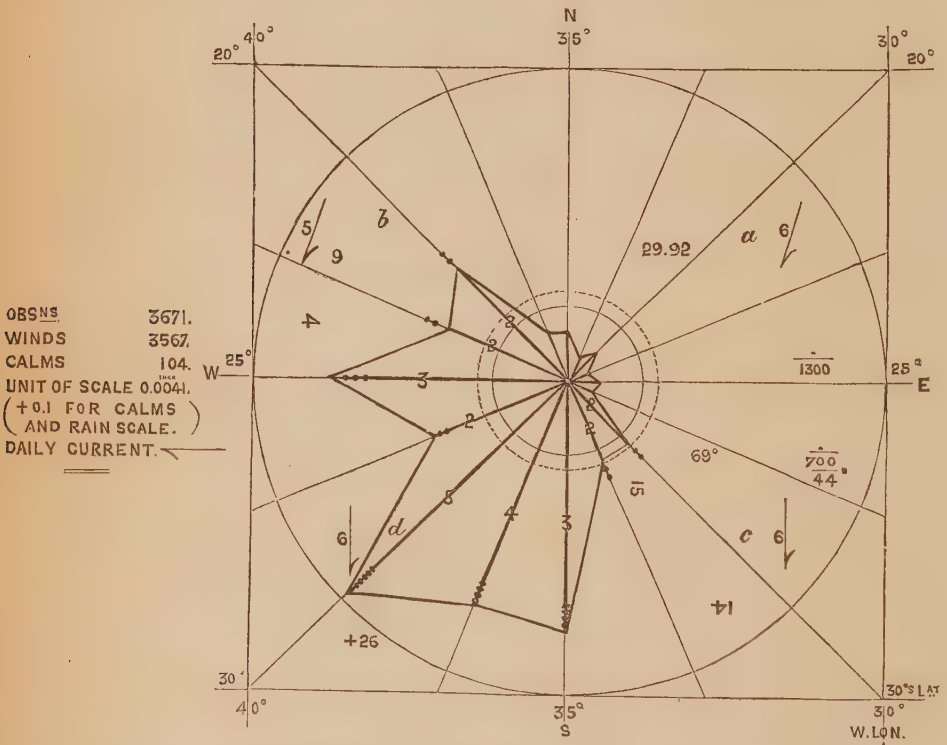
Sub-divided into *a*, *b*, *c*, *d*, which sub-division may be continued by quartering and lettering *a*, *b*, *c*, *d*, as *e*, *f*, *g*, *h*, &c.

SOUTH ATLANTIC.

Brazilian Coast (near Rio de Janeiro).
For Three Months,—January, February, March.

Four of Maury's Wind roses are condensed into this Diagram ; namely, those for

	a	*b*	*c*	*d*
Lats. and Longs.	20°+25° S. 30 +35 W.	20°+25° S. 35 +40 W.	25°+30° S. 30 +35 W.	25°+30° S. 35 +40 W.



Scale of Wind.	1=2=Light.	Temp. sea surf. 69°	Var. ($\frac{1}{4}$ turn).
Beaufort - 1–12 and Land - 1–6	2=4=Moderate.	Depth - - 1,500	Dip ($\frac{1}{2}$ turn).
	3=6=Fresh.	No ground at $\frac{\cdot}{1300}$	Sp. Gr. + 26.
	4=8=Strong.	Temp. at - $\frac{1500}{44°}$	(1,000 + ?)
	5=10=Heavy.	Variation - 4	
	6=12=Violent.	Dip - - 14	

Converted from Maury's Pilot Charts of South

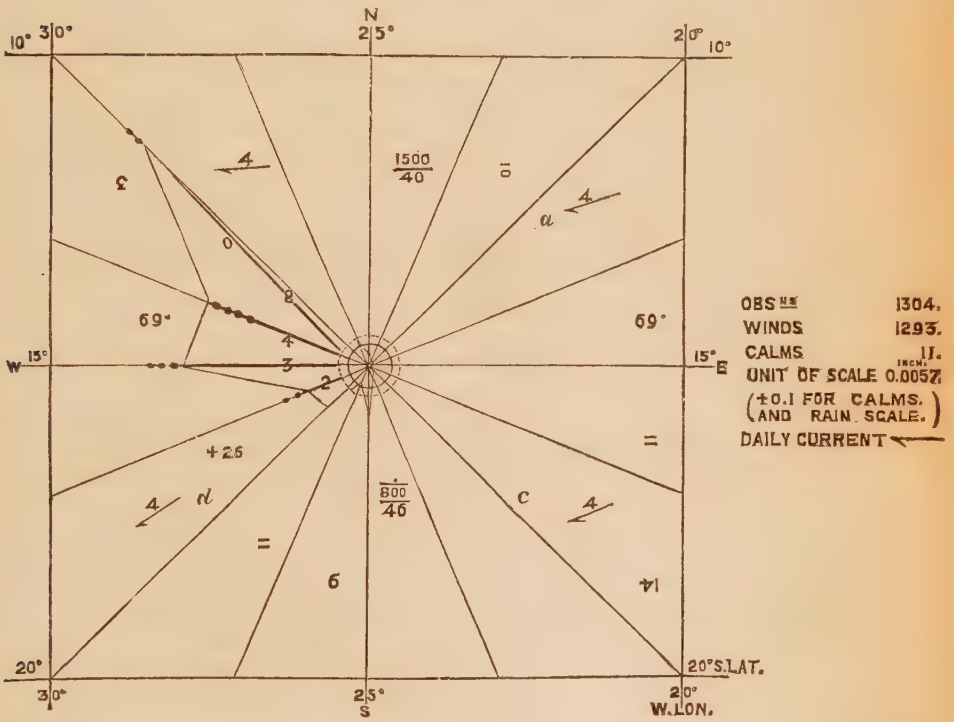
SQUARE 338.

SOUTH ATLANTIC.

Brazilian Coast (near Bahia).

For Three Months,—January, February, March.

Five-inch Square : half one side (=radius of inscribed circle) has 2,500-thousandths of an inch, in which measure the *unit for scale* is taken.



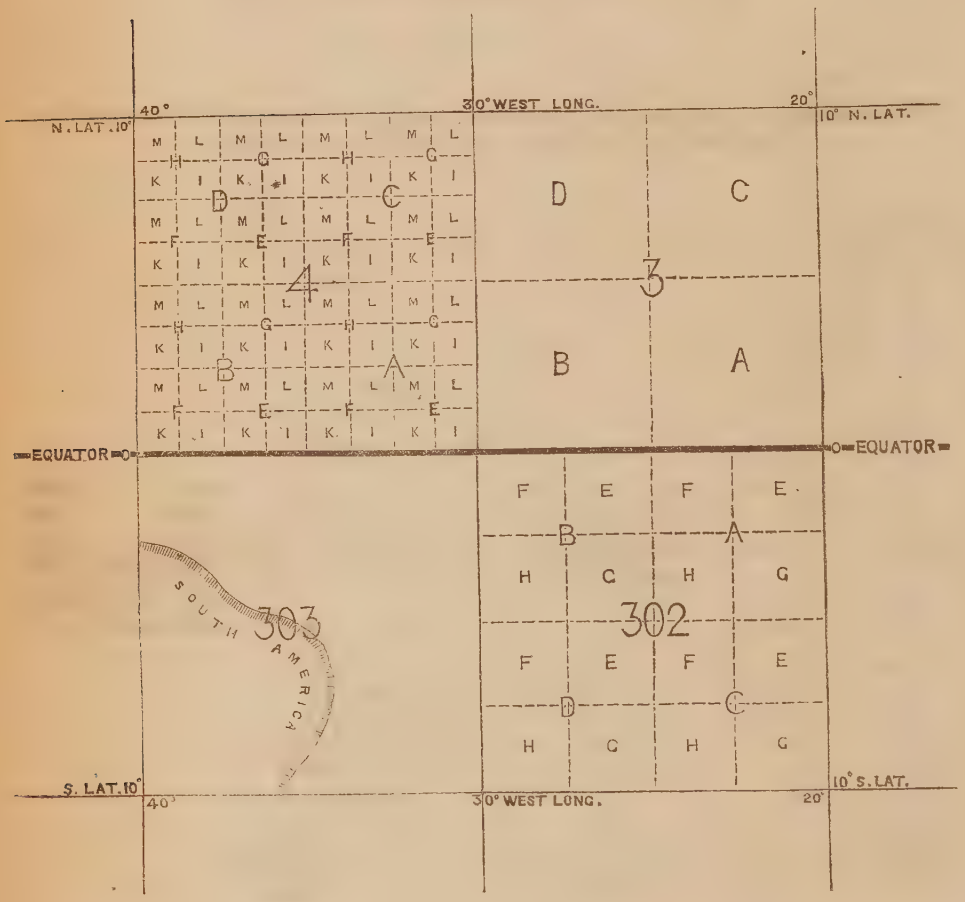
Let. n = number of parts in *radius* (=2,500)
„ n' = „ longest point (*radius*)
„ l = length of *one* part of radius = (·001)
„ l' = length of unit of scale.
then $n' : n :: l : l'$

$$\therefore \frac{n \times l}{n'} = l' = \textit{unit of scale}$$

Log. n (2500)	$=3\cdot3979$
Log. l (·001)	$=\bar{3}\cdot0000$
	$0\cdot3979$
Log. n' = (439)	$2\cdot6425$
Unit of Scale = l' =	$=\cdot0057=\bar{3}\cdot7554$

Atlantic Ocean, Pl. Nos. 12 and 13.

SPECIMEN of the METHOD ADOPTED in the SUBDIVISION of the SQUARES of TEN DEGREES into which the SURFACE of the GLOBE is supposed to be DIVIDED.



N.B.—The letters in the above diagram may be of any character.

APPENDIX B.

Divisions of the Globe and Construction of Wind Charts, &c.

Divisions of the Globe.

The mode of exhibiting barometrical and thermometrical oscillations by diagrams is familiar to most persons ; but, as the method here adopted to show the results of observations of wind, weather, and some other matters graphically, is new, it may require explanation.

The surface of the globe is supposed to be divided into squares of ten degrees each. Beginning at the meridian of Greenwich, on the Equator, the numbers go westward until the same meridian is regained ; then, on the next circle, northwards, between the parallels of 10 and 20 degrees of latitude, and so on, omitting the 10 degrees space of latitude around the pole.

From the first meridian the squares south of the Equator are numbered from 300 in a similar manner, but southwards to the eightieth southern parallel. Thus distinguished by numbers not exceeding 600, all those below 300 being north of the Equator, the locality of each frequented square may soon become fixed in the memory of a navigator, and serve (like provinces on land) to recal spaces to the mind, rather than points indicated only by latitude and longitude.

Observations made in any square may be referred to the centre of that square, as to an observatory at which observations are made daily.

In such spaces it is supposed that meteorological occurrences will not generally be very dissimilar ; and that, if all are referred to the centre of that square, or subdivision of it, in which they occur, the mean result of a great number of observations will give a reliable and approximately correct general average for practical use.

If between each time of observation eight hours elapse, three winds (or calms) may be noted for one day.

During a certain interval of weeks, months, seasons, or years, a number of observations are collected. These are classified and totalled under points of the compass. A circle being inscribed in a square of so many degrees, the greatest number of observations under any point governs the scale of equal parts according to which the numbers of winds under each point are laid down from the centre of the circle leewardly towards its circumference, the longest point being always equal to the radius. Through the extremities of these lines, on points or alternate points of the

compass, a line is drawn, as a curve is drawn through ordinates, and the resulting diagram (sometimes called a wind star) shows the proportion of winds.

The greater area of the figure being to leeward of the centre indicates, at a glance, the *relative* prevalence of wind from particular points, and its relative duration.

As a circle is said to be generated by the revolution of its radius, so a wind star may be said to result from the motion of a vane ; and persistence in any direction may be supposed to increase the length of the corresponding line or point (like the growth of crystals).

The average strength of wind may be shown by parallel lines, or numerically, or by dots ; the per-centage of calms, by a circle of which the radius equals their number (according to the scale of the diagram) ; the per-centage of rain by a dotted circle, on a similar principle ; and oceanic currents by the usual arrows and numbers. In addition may be given, without overloading the paper, confusing the eye, or using colours,* the per-centage of gales or storms (by marks on the point lines), deep-sea soundings, temperature, atmospheric pressure, and the specific gravity of sea water ; besides variation of the magnetic needle, and perhaps other data.

Twelve wind charts for the principal oceans have been published, which show part only of what may be given at a future time.

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* Colours increase the expense of printing.

Maury Conversion—Winds and Calms.

Points of the Compass. 375 *a. b. c. d.*

Sq.	Mo.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
375	1	74	76	35	89	41	58	13	7	4	1	2	3	2	7	21	70
a	2	50	50	43	49	49	19	5	6	2	4	1	2	1	13	18	47
	3	32	40	30	48	42	39	8	10	2	10		4		13	19	71
	1	53	84	17	18	10	10	1	1		2				6	8	32
b	2	32	66	15	24	19	22	14	10	1	4	5	4	2	15	9	20
	3	44	75	26	46	30	31	25	21	13	16	3	11	4	21	12	65
	1	43	33	23	31	11	22		2	2	5	4	5	13	13	11	29
c	2	29	39	15	29	9	17	2	6	4	1	1	2	4	31	27	54
	3	18	22	27	33	11	34	9	8	3	13	4	10	2	8	8	10
	1	23	41	14	12	6	14	6	4		1	3	5		18	9	39
d	2	34	60	11	20	6	12	8	4	1	2	3	4		3	6	12
	3	36	29	12	30	13	16	5	13	2	18	9	18	3	21	11	36
Total	-	468	615	268	429	247	294	96	92	34	77	35	68	31	169	159	485

Winds..... = 3567

Calms..... = 104

Mo.	*a* 1	2	3	*b* 1	2	3	*c* 1	2	3	*d* 1	2	3	
	13	7	18	4	1		14	24	10	13	= 104		Total Observations... = 3671

POINTS OF THE COMPASS. 338 *a. b. c. d.*

Sq.	Mo.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
338	1			2	2	2	12										
a	2			1	5	5	28	5	2								
	3				19	15	53	7	4								
	1		4	3	21	38	73										4
b	2			12	24	43	95	6	1								2
	3	2	9	5	24	17	55	3	1					1	1		
	1				7	7	1							2		3	10
c	2	1	7	14	12	3	7										
	3																
	1		14	28	53	45	18	2						1	1	1	10
d	2	11	20	33	67	39	48	8	3								12
	3	9	23	11	29	22	49	6		1	3		1		4	7	34
Total -		23	77	109	263	236	439	37	11	1	3		1	4	6	11	72

Winds..... = 1293

Mo. *a* 1 2 3 *b* 1 2 3 *c* 1 2 3 *d* 1 2 3 Calms..... = 11

1 1 2 2 5 = 11 Total Observations .. = 1304

APPENDIX C.

Examples of Entries in Data Books.

Barometrical Observations.—North Atlantic.

Ship or Number.	Date.	N. A.		Barometer Corrected and Reduced.											
		3 a.		Latitude, 0°—5° Longitude, 25°—20°											
	y. m. d.	2	4	6	8	9	10	12	2	3	4	6	8	10	12
302	55 VII. 7	..	29·76	..	..	29·79	..	29·77	..	29·84	..	..	29·87	..	..
302 a	56 III. 7	..	·70	..	..	·72	..	·68	..	·62	..	..	·68	..	..
„	„ „ 8	..	·62	..	..	·72	..	·67	..	·62	..	..	·67	..	..
„	„ „ 9	..	·69	..	..	·72	..	·69	..	·66	..	..	·69	..	..
291 b	56 IV. 10	..	·95	..	..	·96	..	·95	..	·92	..	..	·98	..	..
„	„ „ 11	..	·95	..	..	30·00	..	·99	..	·95	..	..	30·00	..	..
„	„ „ 12	..	30·00	..	..	..	..	..	..	·93	..	..	29·99	..	..
„	„ „ 13	..	29·96	..	..	29·99	..	29·96	..	·92	..	..	·98	..	..
283 a	56 III. 8	..	·92	..	..	·92	..	·79	..	·79	..	..	·83	..	..
„	„ „ 9	..	·89	..	..	·90	..	·88	..	·83	..	..	·87	..	..
220	55 V. 18	..	·85	..	..	·94	..	·90	..	·90	..	..	·89	..	..
„	„ „ 19	..	·91	..	..	..	..	·91	..	·89	..	.	·89	..	..
220 a	55 XII. 30	..	·82	..	..	29·89	..	·85	..	·79	..	..	·88	..	..
„	„ „ 31	..	·84	..	..	·89	..	·82	..	·79	..	....	..	..	..
„	56 I. 1	..	·85	..	..	·90	..	·84	..	·80	..	..	29·89	..	..
300	55 II. 7	..	·87	..	..	·97	..	·96	..	·94	..	..	·97	..	..
„	„ „ 8	..	·93	..	..	·97	..	·97	..	·22	..	..	·94	..	..
„	„ „ 9	..	·92	..	..	·98	..	·94	..	·91	..	..	·96	..	..
202	55 IV. 17	..	·92	..	..	·93	..	·93	..	·89	..	..	·89	..	..
„	„ „ 22	..	·90	..	..	·94	..	·94	..	·92	..	..	·92	..	..
203	55 XI. 9	..	·93	..	..	·92	..	·95	..	·91	..	..	·93	..	..
„	„ „ 10	..	·92	..	..	·94	..	·91	..	·85	..	..	.95	..	..
„	„ „ 11	..	·92	..	..	·95	..	·95	..	·89	..	..	·97	..	..
289	56 III. 17	..	·93	..	..	·97	..	·95	..	·89	..	..	·96	..	..
„	„ „ 19	..	·96	..	..	30·01	..	·96	..	·91	..	..	·94	..	..
„	„ „ 20	..	·92	..	..	·01	..	·98	..	·92	..	..	·95	..	..
„	„ „ 21	..	·92	..	..	29·96	..	·94	..	·85	..	..	·87	..	..
„	„ „ 22	..	·88	..	..	·96	..	·92	..	·87	..	..	·92	..	..
286	55 VIII. 11	30·01	30·00	30·01	30·03	30·04	30·05	30·04	30·00	..	29·97	30·01	30·05	30·09	30·07
„	„ „ 12	·00	·00	·02	·06	·07	·08	·03	·00	29·99	30·00	·00	·02	·04	·03
„	„ „ 13	·00	29·98	29·98	·02	·03	·03	·00	29·97	·95	29·94	29·96	29·99	·01	29·99
286 a	56 III. 4	29·97	·91	·96	·01	·03	·04	·02	·97	·95	·94	·96	·99	·02	30·02
213	55 VIII. 7	..	·98	..	..	29·98	..	29·97	..	30·03	..	..	30·06	..	·08
„	„ „ 8	..	30·08	..	..	30·11	..	30·06	..	·03	..	..	·03	..	·07
268	55 VII. 6	..	29·87	..	..	29·89	..	29·91	..	29·94	..	..	29·96	..	..
„	„ „ 7	..	·96	..	..	·94	..	·91	..	·89	..	..	·91	..	..
268 a	56 II. 27	..	·87	..	..	·87	..	·89	..	·85	..	..	·81	..	29·81
„	„ „ 28	..	..	..	..	·88	..	·86	..	·86	..	..	·86	..	·86

EXPLANATION.

The figures in the first column (headed Ship or Number) have reference to the documents from which the observations have been respectively obtained.

The second column supplies the date, the year, month, and day.

The letters N. A., with 3 a. beneath, refer to the *locality*—e. g., all the observations on this page were made in the subdivision a of that particular square of ten degrees in the North Atlantic, to which the number 3 has been assigned—i. e., between the Equator and 5° North Latitude, and between 20° and 25° West Longitude.

The figures at the top of the columns containing the observations represent the hours of the day (civil time).

Ex.—Taking the first entry, 29·76 is the corrected reading of the barometer of the ship "Storm Cloud," at 4 a.m. 7th July, 1855, 29·79 at 9 A.M. on same day, 29·77 at noon, and so on.

The observations are reduced as follows:—

Ex.—The first entry, 29·76, was recorded in the log as ..... +29·880
Correction to scale reading..... + ·002
To reduce to sea-level (10 feet)..... + ·011 nearly
To reduce to 32° Fahrenheit (temperature 79°) .. — ·134

29·759 = 29·76 nearly.

Thermometrical Observations—South Atlantic.

Ship or No. and Date.	Upper A.M. Lower P.M.	S.A.	Dry and Wet Thermometers—in Air (corrected).											
		339 c.	Latitude, 15°—20°. Longitude, 35°—30°.											
	d 2 w	d 3 w	d 4 w		d 6 w		d 8 w		d 9 w		d 10 w		d 12 w	
300 17.2.55		78·3 73·3					78· 72·1		77·8 72·9				79·1	73·1
18.„ „		78·2 72·4	77·	71·9			77·8 73·1		77·6 72·2				78·1	72·6
300 a 18.1.56		78·2 75·3	76·3	74·6			77·5 75·1		78·2 75·3				79·	76·1
19.„ „		80· 76·1	77·5	75·1			78·8 75·9		78·5 75·1				79·3	74·9
286 22.8.55	73·1 68· 73· 66·9	73· 66·8	73· 72·8	67·9 66·8	72·2 72·1	66·8 66·2	72·2 72·	66·3 67·	72·5	66·8	73· 72·	66·6 66·6	73·2 72·	67·2 66·6
23.„ „	71·5 66· 73·2 66·8	73· 66·6	71· 72·7	65·2 66·4	71·8	66·	72·2 71·6	66·3 66·4	73·	66·8	73· 71·4	66·9 66·8	73·8 71·2	66·8 67·1
268 17.7.55		74·8 74·8	73·8	75·8			73·3	75·3	74·8	75·8			75.8	74·8
213 19.8.55		74·8 72·8	73·8	72·8			72·8	72·8	75·8	73·8			74·8 71·8	75·8 70·8
213 a 16.12.55		77·8 75·8	74·8	74·8			75·8	74·8	76·8	74·8			77·8 76·8	75·8 75·8
17.„ „		79·8 78·8	76·8	75·8			78·8	77·8	78·8	76·8			78·8 77·8	77·8 75·8
221 26.5.55		76·7 71·	74·3	70·6			75·9	70·3	75·9	71·			76·1	70·4
27.„ „		74·7 71·	74·1	68·6			73·7	71·8	74·7	70·			74·5	71·2
264 21.8.55		72·8 69·1	73·	69·1			73·	68·9	73·2	69·3			73·	69·3

EXPLANATION.

The columns headed d and w contain the readings, when corrected for index errors, of the dry and wet bulb thermometers respectively.

The upper row of figures in each division are the A.M., the lower the P.M. observations.

In other respects the tabulation is similar to that of the barometrical observations.

Ex.—Taking the observations in the first division, we find that, in the subdivision *c* of the square 339 in the South Atlantic (S.A. 339 c), or between 15° and 20° South Latitude, and between 30° and 35° West Longitude, on 17th February 1855, the temperature of the air was found by the ship "Cambridge" (300) to be 77°·8 at 9 A.M., the wet bulb thermometer showing at the same time 72°·9. At noon on the same day we have, dry bulb, 79°·1; wet bulb, 73°·1; at 3 P.M., 78°·3 and 73°·3 respectively; and so on for the other observations.

In some few instances the temperatures of the wetted thermometer are found to be noted as higher than those of the dry-bulb thermometer.

When this is the case a mistake has probably been made in the entry, but it is possible that the bulb may in some cases have been wetted with water rather warmer than the air, and for a time may have actually raised the temperature of the mercury, instead of lowering it as usualby the effect of evaporation.

Winds and Weather—China Sea.

East.		Winds and Weather.											
26 a.		Latitude 0°—5°. Longitude 105°—110°.											
Ship.	Year.	Month.	Day.	Weather.	Cloud.	North.	N.N.E.	N.E.	E.N.E.	East.	E.S.E.	S.E.	S.S.E.
239	54	10	12	b c	..	..	..	..	..	..	..	2	..
,,	,,	,,	13	b c m	..	0	..	..	..	..	..	..	..
,,	,,	,,	17	o c	..	2' 0'	..	..	..	..	..	..	..
,,	,,	,,	,,	p c q	..	..	..	..	..	..	..	2	..
,,	,,	,,	,,	c m q	..	0'	..	..	..	..	..	3'	..
,,	,,	,,	27	b c o	..	0	..	..	..	..	..	..	..
,,	,,	,,	28	b c	cir.	..	..	..	..	..	..	..	3
,,	,,	,,	,,	b c	..	1' 0'	..	..	..	..	..	..	..
,,	,,	,,	29	b c	..	2	..	..	..	..	..	..	..
,,	,,	,,	30	b c	..	..	..	2	..	..	..	..	..
,,	,,	,,	31	c	..	..	..	..	..	..	..	3	..
,,	,,	11	5	b c	..	1	..	..	..	..	..	..	..
,,	,,	,,	9	o c m	..	..	2	..	..	..	..	..	..
,,	,,	,,	,,	o c m	..	..	..	3'	..	..	..	..	..
,,	,,	,,	10	b c	cir. str.	2' 0'	..	..	..	..	..	..	..
,,	,,	,,	11	b c	..	3	..	..	..	..	..	..	..
,,	,,	,,	13	b c	..	2	..	..	..	..	..	..	..
,,	,,	,,	14	b c q	..	..	6	..	..	..	..	..	..
,,	,,	,,	,,	b c q o	..	..	4	..	..	..	..	..	..
,,	,,	,,	15	b c m o	..	..	..	2	..	..	..	..	..
,,	,,	,,	,,	b c q	nim.	..	..	5	..	..	..	..	..
,,	,,	,,	,,	b c r	nim.	..	3	..	..	..	..	..	..
,,	,,	,,	16	o c d	..	1	..	..	..	..	..	..	..
,,	,,	,,	17	b c	..	..	3	..	..	..	..	..	..
,,	,,	,,	18	b c	..	3	..	..	..	..	..	..	..
,,	,,	,,	,,	b c m	..	..	3	..	..	..	..	..	..
,,	,,	,,	19	c m p	..	..	3	..	..	..	..	..	..
,,	,,	,,	20	b	..	..	3	..	..	..	..	..	..
,,	,,	,,	21	b c	..	..	4	..	..	..	..	..	..
,,	,,	,,	22	b c	..	..	3	..	..	..	..	..	..
,,	,,	,,	,,	b c	..	..	..	2	..	..	..	..	..
,,	,,	,,	,,	b c	..	..	..	4	..	..	..	..	..
268	55	9	13	c	cremstr	..	..	..	..	..	..	4	..

EXPLANATION.

This page contains a record of Winds (from the eastern half of the compass) and Weather, in square 26a, China Sea, i.e. between the Equator and 5° N. lat. and 105° and 110° E. long.

The figures represent the average force of the wind for a period of eight hours, the Beaufort notation (1—12) being used. A cypher represents a calm.

A mark close under any entry signifies that that entry refers to only half a full period, or to an interval of four hours.

Ex. 1.—The first entry is a note by H.M. Ship "Lily," of a very light breeze from S.E., on 12th October 1854, the weather being fine, blue sky with detached clouds.

N.B. Three observations (periods of eight hours) in each space.

Ex. 2.—The third entry is a report, by the same ship, on the 17th of the same month, of overcast weather with detached clouds, a very light N. breeze for four hours, followed by a calm of same duration, then a very light S.E. breeze for eight hours, with passing showers, detached clouds, and squally weather. The remaining period of eight hours was divided between a calm and a light breeze from S.E. with detached clouds, misty atmosphere, and squally weather.

Winds and Weather—China Sea.

West.		Winds and Weather.											
26 a		Latitude 0°—5° Longitude 105°—110°.											
Ship.	Year.	Month.	Day.	Weather.	Cloud.	South.	S.S.W.	S.W.	W.S.W.	West.	W.N.W.	N.W.	N.N.W.
253	54	9	11	b c	cum.	4	..	..	..	..	..	..	..
„	„	„	13	b c m	..	2	..	..	..	..	..	..	..
„	„	„	14	b c	cm. str.	..	..	1	..	..	..	..	..
„	„	„	14	b c	..	..	..	..	..	1	..	..	..
„	„	„	„	c l	nim.	0	..	..	..	..	..	..	..
„	„	„	15	b c	..	..	..	..	..	2	..	..	..
„	„	10	9	b c	..	..	..	..	..	..	..	1	..
„	„	„	10	o r q	..	..	..	4	..	..	..	..	..
„	„	„	„	b c	nim.	..	..	..	..	..	..	2	..
„	„	„	„	b c	..	..	..	..	..	..	..	..	3
„	„	„	11	c	..	..	..	..	..	..	..	..	1
„	„	„	„	c g u p	nim.	..	..	..	..	3	..	..	..
„	„	„	12	b c		..	..	..	..	..	..	..	..
„	„	„	„	c	—	..	..	..	..	..	..	..	1
„	„	„	13	b c		..	2	..	..	..	..	..	..
„	„	„	15	b c	cir.cum.	0'	..	..	..	..	..	1'	..
„	„	12	7	b c		..	..	..	..	..	..	2	..
„	„	„	„	c		..	..	..	..	..	..	..	1
„	„	„	8	b c m	..	..	..	..	..	..	..	..	2
„	„	„	„	b c	..	..	..	..	..	..	..	..	3
„	„	„	9	b c	..	..	..	..	..	..	1	..	..
„	„	„	10	b c	..	..	..	..	..	1	..	..	..
„	„	„	11	c	..	..	2	..	..	..	..	..	..
„	„	„	„	b c	..	..	..	..	..	..	2	..	..
„	„	„	12	c p q r	..	0'	..	..	..	3	..	..	..
„	„	„	„	b c	..	..	..	..	..	..	1'	..	..
„	„	„	30	b c	cir.	..	..	..	..	2	..	..	..
„	„	„	„	b c	..	0' 1'	..	..	..	..	..	..	..
239	54	4	19	b c o p	..	..	..	..	..	..	3	..	..
„	„	„	„	b c	..	..	..	..	..	2	..	..	..
„	„	„	20	b c	..	..	..	..	..	1	..	..	..
„	„	„	„	b c	cir. str.	..	2	..	..	..	..	..	..
„	„	„	„	b c	..	..	..	..	1	..	..	..	..

EXPLANATION.

This page contains a record of Winds, from the western half of the compass—Weather and Cloud tabulated in a manner precisely similar to the preceding.—(Three entries in each space) (each line=8* (or 4) hours.)

Ex.—In the third division H. M. S. "Rapid" reports on 10th Oct. 1854 a fresh breeze from S. W., overcast weather, rain, and squalls; middle part, light N. W. breeze, blue sky, and detached clouds (nimbi); latter part, moderate breeze from N. N. W., blue sky, with detached clouds.

* First part=8; middle part=8; last part=8=24 hours.

Temperature of Sea at Surface and Depth, and Specific Gravity, South Atlantic.

S.A.		Sea-Water.												
409		Latitude, 30°—40°. Longitude, 20°—10°.												
Ship	Year.	Month.	Day.	Latitude.		Longitude.		Current.		Temperature.	Specific Gravity.	Depth.	Temperature.
				°	′	°	′						
76	38	9	18	30	35	19	18			59·1			
	,,	,,	19	32	06	18	31			58·1			
	,,	,,	20	33	02	16	29			59·2			
	,,	,,	21	32	02	13	19			56·8			
	,,	,,	22	32	15	10	07			59·0			
80	50	,,	23	31	20	16	58			62·0			
	,,	,,	24	32	54	13	31			62·0			
	,,	,,	25	34	07	13	23			59·0			
	,,	,,	26	34	17	11	46			58·0			
I.	54	4	14	36	37	10	11	N.E. b. N.	17	63·1	28·2		
,,	,,	,,	,,	,,	,,	,,	,,			64·7			
,,	,,	,,	,,	,,	,,	,,	,,			63·4			
,,	,,	,,	15	36	29	12	20	N.W. ½ W.	55	62·2	27·9	$\frac{\cdot}{300}$	52·0
,,	,,	,,	,,	,,	,,	,,	,,			64·3			
,,	,,	,,	,,	,,	,,	,,	,,			64·6			
,,	,,	,,	16	36	24	16	30	N.E. b. E.	25	65·2	27·6		
,,	,,	,,	,,	,,	,,	,,	,,			66·0			
,,	,,	,,	,,	,,	,,	,,	,,			65·2			
,,	,,	3	30	31	38	19	12			70·5	29·4		
,,	,,	,,	,,	,,	,,	,,	,,			69·7			
,,	,,	,,	,,	,,	,,	,,	,,			69·6			
,,	,,	,,	31	31	52	17	28	N. b. E.	15	69·6	29·2	$\frac{\cdot}{300}$	49·5
,,	,,	,,	,,	,,	,,	,,	,,			70·7			
,,	,,	,,	,,	,,	,,	,,	,,			69·8			
,,	,,	4	1	33	27	17	4	West	7	68·5			
,,	,,	,,	,,	,,	,,	,,	,,			67·8			
,,	,,	,,	,,	,,	,,	,,	,,			66·8			
,,	,,	,,	2	35	2	15	15	East	19	65·8			
,,	,,	,,	,,	,,	,,	,,	,,			65·7			
,,	,,	,,	,,	,,	,,	,,	,,			64·6			
,,	,,	,,	3	35	47	13	36			64·1	28		
,,	,,	,,	,,	,,	,,	,,	,,			64·0			
,,	,,	,,	,,	,,	,,	,,	,,			64·2			

In these instances—temperatures taken at 8 a.m.

Temperature taken three times a day.

EXPLANATION.

The sea-water observations for each square of 10° are kept distinct. All on this page were, as shown by the heading (S. A. 409), taken in square 409 in the South Atlantic, i.e. between 30° and 40° S. latitude, and between 10° and 20° W. longitude.

The first of the columns headed "Temperature" contains the "temperature" of the sea at surface, given three times per day; the last column is for temperature at certain depths whenever obtained.

The mode of notation is obvious:—

Ex.—In the fifth division from the top, on the 15th April 1854, in latitude 36° 29′ S. and longitude 12° 20′ W., the "Saracen" (I.) reports a current N.W. ½ W., setting 55 miles in 24 hours, temperature at surface varying from 62°·2 to 64°·6. Specific gravity at surface 1027·9, and temperature of water at a depth of 300 fathoms, without finding bottom, 52°.

Miscellanea.

Authority and Date.				Ice.			Temperature of	
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Air.	Water.
84	55	VI.	30	North. 45° 17′	Large berg, about 180 feet high.	West. 47° 47′	49°	48°

Authority and Date.				Aurora Borealis.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Time.
205	55	XII.	3	49° N.	Forming an arch extending from N.E. by E. to N.W.; streams of light occasionally shooting up to 15° or 20° above the arch; most brilliant about 9 P.M.; of a dull yellow colour.	42° W.	5 P.M. to 11 P.M.

Authority and Date.				Meteoric Appearances.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Time.
202	55	VI.	20	5° S.	A large meteor to northward fell with a noise like a rocket.	59° E.	10 P.M.
204	55	XII.	6	3° N.	Many shooting stars in N.E. falling perpendicularly.	26° W.	About 9 P.M.

Gales or Storms (in November.)							Barometer.	
Ship.	Date.	Wind.	Force.	Latitude.	General Nature.	Longitude.	Greatest Depression.	Time.
82*	20th 54	S.S.E. to S.W.	12	North. 23° 52′	Hurricane from 11 A.M. to 5 P.M., when more moderate.	East. 143° 17′	28·48	2 P.M.

Authority and Date.				Thunder, Lightning, or Hail.			
Ship.	Year.	Month.	Day	Latitude.	Description.	Longitude.	Time.
202	55	V.	23	South. 36° 32′	Heavy shower of hail; lightning to N.W.	East. 31° 40′	About noon.

* Ship's log or document 82 contains many further details.

Miscellanea.

Authority and Date.				Dangers (Vigia), &c.		
Ship.	Year.	Month.	Day.	Latitude.	Remarks.	Longitude.
4	54	V.	1	North. 4° 29′	Being near the spot marked "French Shoal" on chart, tried for soundings, with 100 and 160 fathoms, without bottom. Sea showed two distinct swells from N. and S. respectively. Many birds about, principally "Portuguese Men-of-War."	West. 20° 34′

Authority and Date.				Whales Observed.			No. seen.	Temperature of water.
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.		
205	55	IX.	18	52° N.	"Greenland," also "Finbacks" in hundreds.	54° W.	10 or 12	37°

Authority and Date.				Birds, Fish, &c.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Remarks.
4	54	II.	26	14° N.	Flying fish in great numbers.	21° W.	Flying towards South.
4	54	IV.	15	34° N.	Turtles seen. Swallows about the ship.	12° W.	The swallows all flew eastward.

Authority and Date.				Drift-wood, Sea-weed, Tide-ripples, &c. &c.			
Ship.	Year.	Month.	Day.	Latitude.	Description.	Longitude.	Remarks.
205	55	IX.	2	North. 51° 22′	Colour of water changed from blue to green.	West. 24° 40′	Temperature of water fell from 60° to 57°.
205	55	IX.	17	North. 52° 14′	Drift-wood—boughs of pine trees.	West. 53° 30′	Wood recently drifted; no weeds on it.

From the Channel to

In April.		Crossings of Parallels. North Latitude. West Longitude.											
Ship.	Date.	45°		40°		35°		30°		25°		20°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
			°		°		°		°		°		°
221	22/55	2	15	5	19	2½	20	1½	22	2	23	1½	24
227	20/55	2	15	2	18	2	19	3	21	3	24	2½	25

From the Fifth Southern Degree

In October.		Crossings of Parallels. South Latitude to North. West Longitude.											
Ship.	Year.	5°		0°		5°		10°		15°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
			°		°		°		°		°		°
201	55	3rd	29	1½	29	1½	28	4	29	1½	33	1½	34
221	55	22d	17	3	20	4	21	5	21	5	29	2	31

From the Fifth Northern Degree

In July.		Crossings of Parallels. North Latitude to South. West Longitude.											
Ship.	Year.	5°		0°		5°		10		15°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days,	Long.
			°		°		°		°		°		°
219	55	8th	30	2	33	4	33	3	35	2	36	2	38
302	55	6th	23	2	27	1½	30	3½	32	3	34	1½	33

From the Forty-fifth Southern Degree

In December.		Crossings of Parallels. South Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
			°		°		°		°		°		°
216	55	1st	39	2	34	3	27	2	27	2	27	4	29
219	55	26th Nov.	40	3	33	3	28	4	27	2	26	4	26

the Fifth Southern Degree.

In April.		Crossings of Parallels. North Latitude to South. West Longitude.											
Ship.	Date.	15°		10°		5°		0		Days		5° South.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Channel.	From First Trade.	Days.	Long,
			°		°		°		°		°		°
221	22/55	1	25	1½	25	4	23	4	29	25	14	2	31
227	20/55	1½	26	2	24	3	22	5	25	26	15	3	29

to the Channel.

In October.		Crossings of Parallels. North Latitude. West Longitude.										Days to Channel.	
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days	Long.	From Equator.	From 5° S.
			°		°		°		°		°		
201	3/55	2½	35	1	34	1½	32	1½	25	2½	19	20½	22
221	22/55	3	35	9	36	4	35°	5	25	5	23	52	55

to the Forty-fifth Southern—Atlantic.

In July.		Crossings of Parallels. South Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° N.
			°		°		°		°		°		
219	8/55	2	41	4	44	3	48	3	52 W.	3	59	26	28
302	6/55	3½	31	2	27	3	15	5	10 E.			23	25

to the Fifth Northern—Atlantic.

In December.		Crossings of Parallels. South Latitude to North. West Longitude.											
Ship.	Date.	15°		10°		5°		0		Days.		5°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From 45° S.	From 1st Trade.	Days.	Long.
			°		°		°		°				°
216	1/55	6	30	2	31	1½	31	2	31	24½	10	3½	31
219	26/11/55	5	30	3	32	2	32	2	31	28	9	4	34

From the Forty-fifth Southern Degree

In December.		Crossings of Parallels. South Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	55	25th.	82 W.	2	81	3	82	3	78	4	78	3	84

From the Fifth Northern Degree

In May.		Crossings of Parallels. North Latitude to South.											
Ship.	Year.	5°		0°		5°		10°		15°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	56	8th.	103W.	3	109	3	112	2½	115	1½	117	2	118

From the Fifth Southern Degree

In January.		Crossings of Parallels. South Latitude to North.											
Ship.	Year.	5°		0		5°		10°		15°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	56	17th	94W.	3	98	4	101	5	105	3	110	6½	108

From the Forty-fifth Northern Degree

In April.		Crossings of Parallels. North Latitude.											
Ship.	Year.	45°		40°		35°		30°		25°		20°	
No.	1800	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
355	56											21st	109 W.

to the Fifth Northern—in the Pacific.

In December.		Crossings of Parallels. South Latitude to North.											
Ship.	Date.	15°		10°		5°		0°		Days.		5° North.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From 45° S.	From First Trade.	Days.	Long.
355	25/55	2½	° 87 W.	3	° 91	2½	° 93	3	° 97	26	14	4	° 101

to the Forty-fifth Southern—in the Pacific.

In May.		Crossings of Parallels. South Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° N.
355	56	4	° 121	2½	° 118	2½	° 112	2	° 106	3	° 101	23	26

to the Forty-fifth Northern—Pacific.

In January.		Crossings of Parallels. North Latitude.											
Ship.	Date.	25°		30°		35°		40°		45°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 5° S.
355	17/56	2½	° 108 W.									21	24

to the Fifth Southern—Pacific.

In April.		Crossings of Parallels. North Latitude to South.											
Ship.	Date.	15°		10°		5°		0		Days.		5°	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From highest Latitude.	From First Trade.	Days.	Long.
335	56	3	° 108 W.	5	° 106	7	° 103	5	° 109	20	17	3	° 112

From the Tenth Northern Degree to

In January.		Crossings of Parallels. North Latitude to South. East Longitude.											
Ship.	Year.	10°		5°		0°		Days.		5° South.		10°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	From 10° N.	Out.	Days.	Long.	Days.	Long.
			°		°		°				°		°
302	56	13th	85	1½	85	3½	82	5	12 from Calcutta.	3	83	2½	82
286	56	24th	59	3½	54	3½	50	7	16 from Bombay.	3	47	3	43

From the Thirty-fifth Southern Degree

In October.		Crossings of Parallels. South Latitude. East Longitude.											
Ship.	Year.	35°		30°		25°		20°		15°		10°	
No.	1800.	Day.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.
			°		°		°		°		°		°
286	55	4th	55	6	60	2½	61	2	61	1½	61	2	61
302	55	13th	113	2½	106	4½	100	3	95	2	91	2	89

Limits of Trade Winds.

In July.		Trade Winds—Atlantic Ocean.											
		North East.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
		°	°	°	°	°	°	°	°	°	°	°	°
302	55	27 N.	22	12	25	10	26	6 N.	25	5 N.	25	22 S.	32

In May.		Trade Winds—Pacific Ocean.											
		North East.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
		°	°	°	°	°	°	°	°	°	°	°	°
355	56	16 N	108 W.	11 N.	107	11	107	7 N.	105	6 N.	104	24 S.	121

the THIRTY-FIFTH SOUTHERN—INDIAN OCEAN.

In January.		Crossings of Parallels. South Latitude. East Longitude.											
Ship.	Date.	15°		20°		25°		30°		35°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Long.	From Equator.	From 10° N.
			°		°		°		°		°		
302	13/56	2	76	1½	72	3	62	7	40	6	26	25	30
286	24/56	3	42	7	41	5	36	3	34	4	25	28	35

to the TENTH NORTHERN—INDIAN OCEAN.

In October.		Crossings of Parallels. South Latitude to North. East Longitude.											
Ship.	Date.	5°		0°		Days.		5°		10°		Days.	
No.	1800.	Days.	Long.	Days.	Long.	From 35° S.	From 1st Trade.	Days.	Long.	Days.	Long.	From Equator.	From 35° S.
			°		°				°		°		
286	4/55	3	62	5	65	22	14	5	66	8	67	13	35
302	13/55	2	88	3	89	19	11	3	90	3	89	6	25

LIMITS of TRADES and MONSOONS.

In January.		Trade Winds and Monsoons—Indian Ocean. North East or South West.				Equatorial Calms.				South East.			
Ship.	Year.	North Limit.		South Limit.		North Limit.		South Limit.		North Limit.		South Limit.	
No.	1800.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
		°	°	°	°	°	°	°	°	°	°	°	°
302	56	18 N.	89	2 N.	82	1 N.	82	6 S.	83	6 S.	83	30 S.	39

In September.		Monsoons—China Sea. North Latitude. East Longitude.											
Ship.	Year.	N.E. or S.W.	Meridians.										
No.	1800.		100°	103°	106°	109°	112°	115°	118°	121°	124°	127°	130°
					°		°						
268	55	S.W.			2 N.		15 N.						

APPENDIX D.

List of Ships.

First List.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *excellent.*

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Boyd, A. McNeil	8	Sir R. Abercrombie	799	Alloa	Tod.
English, G. W.	8	Madras	1,000	London	Avery.
Fitzsimons, W. R.	8	Fulwood	1,160	Liverpool	J. Palmer & Co.
Gales, J.	8	Florence Nightingale	500	Liverpool	R. Girvan.
Lidbetter, Thos.	8	Swarthmore	923	Liverpool	J. Thompson.
Quirk, W.	8	Mencius	510	Liverpool	Atkin & Co.
Toynbee, H.	10	Gloriana	1,056	London	Smith & Co.
Trivett, J. J.	8	Statesman	874	London	Marshall & Co.
Wood, A. D.	8	Queen's Hill	612	Liverpool	J. Alexander.

Second List.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *very good.*

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Barnes, H. D.	6	Patriarch	1,066	Liverpool	J. R. Wilson.
Bichard, P.	8	Leopard	300	Jersey	J. Bichard & Co.
Bowlby, C. H.	8	Charles Holmes	886	Liverpool	Thos. Chilton, Jun.
Browse, E.	8	Seringapatam	774	Liverpool	Cotesworth & Co.
Campbell, J.	8	Storm Cloud	1,012	Glasgow	Stephen & Sons.
Carlyle, J.	8	Startled Fawn	1,330	Liverpool	G. H. Fletcher & Co.
Cass, J.	8	Caduceus	1,200	Plymouth	J. B. Wilcocks.
Cornforth, Jos.	8	Tippoo Saib	1,022	Liverpool	Jones, Palmer, & Co.
Cowell, J.	8	Anna	485	Liverpool	Jones, Palmer, & Co.
Crowdie, W.	2	White Eagle	1,100	Glasgow	Stephen & Sons.
Dallas, J.	8	Fiery Cross	686	Glasgow	J. Campbell.
Deas, R.	16	Conflict	1,326	Liverpool	J. Smith, Jun.
Evans, R. W.	4	Alma	2,500	Liverpool	P. & O. S. N. Comp.
Enright, A.	10	Lightning	2,093	Liverpool	J. Baines & Co.
Fairlem, H.	8	Evangeline	953	Liverpool	Clint & Co.
Faulkner, J. H.	8	Typhoon	1,316	Liverpool	Richardson & Co.
Fowler, J.	8	Joshua	804	Liverpool	Prowse & Co.
Gilkinson, R. B.	8	Alma	591	Port Glasgow	R. Gilkinson.
Heddle, J.	6	Calliance	822	Sunderland	J. Hay.
Herron, J.	8	Lord Raglan	1,962	Liverpool	J. B. Carrol.
Hewitt, H. W.	8	Cambridge	1,225	Liverpool	Jones, Palmer, & Co.
Heyller, A.	12	Cossipore	834	London	Lindsay & Co.
Hinds, C.	8	Collingsburgh	474	Newcastle	D. Cowan.
Johnston, T.	8	United Kingdom	1,267	Belfast	Corry & Co.
Kennedy, J. B.	8	Medway	850	London	Marshall & Co.
Liddle, R. R.	12	Bride	565	London	Temperley & Son.
Lidston, J.	8	Fanny Forsyth	1,342	Liverpool	E. Bates.
Morris, H.	8	Earl Balcarras	1,488	London	McLeod & Co.
Paige, H. W.	8	Cambodia	1,000	London	W. Mann.
Pole, W. W.	8	Thomas Hamlin	1,200	London	G. Hamlin & Co.
Saabye, L.	8	Benjamin Howard	721	Copenhagen	G. O'Hara Taaffe.
Samson, J.	8	Try	774	Bristol	Whitnell & Co.
Simson, G.	8	Stuart Wortley	873	London	Sir G. E. Hodgkinson.
Smith, G.	8	Tinto	779	Bridgewater	Burstall & Co.
Spence	4	Columbine	420	Hull	T. Thompson & Co.
Steel, J.	8	Crest of the Wave	856	Liverpool	Brice, Friend, & Co.
Vinnis, F.	6	Cornelia	1,282	Liverpool	Johnstone & Sons.
Warner, H.	4	Donald McKay	2,565	Liverpool	J. Baines & Co.

Third List.

The Observations made with Instruments and the Remarks in these Meteorological Registers are *good*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Armitage, G. R.	8	William Hutt	285	London	Betts, Peto, & Co.
Black, A.	8	Hercyna	857	Liverpool	Holderness & Co.
Black, A.	6	Rival	260	London	Young & Co.
Boyce, F.	6	Royal Charter	2,160	Liverpool	Gibbs, Bright, & Co.
Brown, A.	8	Chimera	761	Liverpool	H. Moore & Co.
Brownrigg, E. L.	4	James Carthy	—	Liverpool	Derbishire and Co.
Carmichael, J.	14	Fusilier	503	Liverpool	Cotesworth & Co.
Clarke, J.	8	Marco Polo	1,625	Liverpool	Baines & Co.
Dalison, F. S.	6	Advance	612	Liverpool	Moore & Co.
Fox, John	6	Anne Royden	1,140	Liverpool	Thos. Royden.
Fox, Thos.	2	War Cloud	1,250	Liverpool	Oxley & Co.
Gales, J.	4	Florence Nightingale	500	Liverpool	R. Girvan.
Geerkin, L.	4	Hansa	2,500	Bremen	W. A. Tritze & Co.
Hamm, H. P.	6	Joseph Tarratt	992	Liverpool	J. Baines & Co.
Henry, J.	8	Livingston	467	Liverpool	Hatton & Co.
Jobson, D. F.	4	Indian Queen	1,050	Liverpool	J. Baines & Co.
Jones, H.	8	Ballarat	743	London	W. O. Young.
Jones, Thos.	4	Indian	1,800	Glascow	Allan & Gillespie.
Jopp, J.	10	Glenray	1,220	Glasgow	P. and T. Aikman.
M'Donnell, Chas.	6	James Baines	2,515	Liverpool	J. Baines & Co.
M'Kirdy, J.	10	Champion of the Seas	2,237	Liverpool	J. Baines & Co.
Morgan, R.	4	Arundel	868	Bridgewater	Burstall & Co.
Murphy, M.	6	Eagle	1,050	Liverpool	Gibbs, Bright, & Co.
Noakes, E.	8	Malabar	647	London	R. Green.
Orkney	4	Spectre	434	Glasgow	Handysides & Co.
Pearson, A.	8	Glenalva	1,051	Greenock	A. Adams.
Pirrie, W.	4	America	1,670	Liverpool	H. D. Sinclair.
Pope, W. H.	8	Alfred	1,400	London	Green & Co.
Powell, Chas.	2	Khersonese	1,704	Liverpool	J. Alexander.
Rea, J. W.	8	Ingleborough	401	Liverpool	Hornby & Co.
Reid	4	Sarah Palmer	1,440	Liverpool	J. Palmer & Co.
Rooke, J.	4	Harvest Home	677	Liverpool	Blythe & Troughton.
Rudolph, L. E.	8	Tasmania	1,217	Glasgow	P. & T. Aikman.
Samson, T.	10	Try	774	Bristol	Whitnell & Co.
Smith, Thos.	6	Robert Pulsford	551	Liverpool	J. Brocklebank.
Taylor, H. G.	4	Mona	395	Liverpool	J. Aikin.
Thomson, J.	8	Bucephalus	1,340	Liverpool	Johnstone & Sons.
Tobin, J. J.	4	Ocean Chief	1,092	Liverpool	J. Baines & Co.
Turpin, W. H.	8	Rapido	299	Liverpool	J. Moudell.
Warner, H.	2	Donald M'Kay	2,565	Liverpool	J. Baines & Co.
Wherland, F.	4	Star	727	Liverpool	J. R. Graves.
Wilkinson, W.	6	Utopia	947	Liverpool	W. Sharp.
Wilson, W.	12	Lady Hodgkinson	946	London	Sir G. E. Hodgkinson.

Fourth List.

The Observations made with Instruments and the Remarks in the Meteorological Registers are *ordinary*.

Captain's Name.	Months of Register.	Ship.	Tons.	Port.	Owner.
Haliday, A.	6	Valdivia	473	Liverpool	Nicholson & Co.
Noble, John	6	Earl of Sefton	1,126	Liverpool	C. Moore.
Pickernell, J.	4	Beemah	887	Liverpool	Willis & Co.
Pollock	12	African	888	Belfast	J. C. Gregg.
Verrill, B.	8	Howden	1,200	Liverpool	Holderness & Co.

APPENDIX E.

Instructions and Letters.

Office of Committee of Privy Council for Trade,
Sir, Marine Department, Sept. 1854.

I am directed by the Lords of the Committee of Privy Council for Trade to invite the attention of the

* * * *

to the accompanying Report of the Conference which, on the suggestion of Lieutenant Maury, of the United States navy, was held at Brussels, on the subject of establishing an uniform system of meteorological observations at sea, and concurring in a general plan of observations on the winds and currents of the ocean, with a view to the acquirement of a more correct knowledge of the laws which govern the motion of those elements, and to the improvement of navigation.

In consequence of the suggestions contained in that Report, Her Majesty's Government has submitted, and Parliament has sanctioned, a vote for instruments, and for the tabulation of logs, and other meteorological records; and Captain Fitzroy, of the Royal Navy, has been appointed to assist this Board in the discussion of the observations.

The object of the arrangements will be to attain, if possible, to such an improved knowledge of the currents of the ocean, and of the direction of the prevailing winds, as may materially diminish the risk and labour of navigation, and shorten the duration of voyages.

As an acknowledgment for the pains and attention of such captains of foreign-going ships as are willing to co-operate with Her Majesty's Government in this undertaking, and as are competent to fulfil the conditions required of them, it is proposed to place a distinguishing mark against their names in the Mercantile Navy List, and to give copies of the charts and books, which will be printed from time to time from their own and their brother officers' observations, during the time they continue to contribute. These books and charts will contain information as to the prevailing winds and currents in the part of the ocean of which they treat, and of the most desirable tracks to follow, in order to make the surest and quickest passages, and how to avoid or mitigate the violence of hurricanes, &c.

And further, to such captains as will undertake to fill up the columns of the abstract logs, and to make observations, at the

hours denoted by the principal figures, for their successive voyages, the United States Government have directed to be furnished, gratis, a set of charts and sailing directions of Lieutenant Maury, of the United States navy, for the part of the ocean they are navigating.

In order to facilitate the desired co-operation, standard instruments have been prepared, and may be obtained at a diminished cost, for the use of the Merchant Navy.

My Lords are in hopes that the object of this undertaking, and the inducements held out to those who are willing to co-operate in it, will be considered by the more wealthy shipping companies and private shipowners of sufficient importance to induce them to encourage the officers in command of their ships to undertake these observations, and to furnish some, at least, of their captains with the requisite instruments; but in other cases, in order to render the experiment as extensive as possible, instruments will be furnished by the Marine Department of this Board to captains desiring to have them, and giving sufficient proof of their attainments. The extent to which their Lordships may be able to do this will, however, be limited to the means placed by Parliament at their Lordships' disposal, and my Lords are not prepared to pledge themselves to continue it in future years.

I am to add that it is very desirable that any captains of foreign-going ships who may be willing to avail themselves of the privileges mentioned above should communicate with as little delay as possible with this department, either directly, or through the agents appointed for this purpose at the outports.

I am, Sir,
Your obedient servant,
JAMES BOOTH.

INSTRUCTIONS for the AGENTS of the BOARD OF TRADE for METEOROLOGICAL PURPOSES.

1. The agent will take charge of, examine, and compare, issue and receive back the instruments and register books supplied by the Board of Trade.

2. He will keep accounts of all transactions on behalf of the Board of Trade, and will correspond with the secretary on all official matters.

3. It will be an essential object to ascertain that the captains who undertake to make meteorological observations are sufficiently qualified, and that their ships are destined to perform suitable voyages; but to do this in a proper manner without direct interference, which will not be expected of the agent, will require discretion and tact on his part in making his inquiries.

4. The agent will inspect damage done to instruments by carriage, or by casualty at sea, and will send such as are broken to be repaired.

5. He will, when applied to by the captain of a ship, either rate and compare his chronometers,* or he will advise him respecting the best local means of having them rated and compared.

6. The agent will satisfy himself, on the part of the Board of Trade, either by personal investigation (by permission of the captain), or by the report to himself made by a competent person, that the compasses of ships undertaking to make meteorological observations are good, that she has an azimuth compass on board, and that it has been duly placed and properly examined for deviation, and that it is wholly uncorrected by magnets or other means.

7. The agent will always be on the look out for, and duly report, the names of such ships and captains as it may be desirable to invite to take part in meteorological observations.

8. The agent will endeavour to guard against the waste of instruments lent for a time by the Board of Trade, by removing them from the ship on her return from abroad. If such ships are going out again on suitable voyages, they are to make fresh application for instruments.

9. He will send a list of all instruments received, describing their condition, to the Board of Trade.

10. With the standard instruments supplied to him, the agent will compare all others that are referred to him for examination.

11. Every ship supplied with instruments, or a meteorological register, will be reported to the Board of Trade; and from time to time lists of such ships will be forwarded to all the agents.

12. All instruments when supplied are to be entered in the 5th page of the Meteorological Register; a duplicate list of them is to be kept by the agent, and a triplicate forwarded to the Board of Trade.

13. In each case of supply the agent will obtain the authority of the Board of Trade, for whose satisfaction he will state briefly in his letter of application the chief reasons for proposing the supply.

14. As it is desirable to spread meteorological observations as widely as possible, the agent is to report the destination of each vessel applying for instruments, in order that a selection may be made, if necessary.

15. Any owner of a British ship going foreign, and commanded by a captain approved by the Board, will be supplied, on his application to the agent, with instruments at the low prices fixed by the Board, and with a Meteorological Register gratis, provided that the captain will undertake to make and record the required observations, and compare the instruments with an agent's standard on his return to port in the United Kingdom, and to return the register properly kept. Or, instead of purchasing *all* the necessary instruments, he may be supplied with only one or more,

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* For which payment will be made by special agreement.

provided his own instruments on board are approved and duly compared with a standard.

16. Such ships will be furnished with Lieutenant Maury's charts of the winds, currents, &c., of the parts of the world to be traversed by them, and also with a copy of his sailing directions, provided that the owner or captain will undertake to comply with the annexed conditions.

17. Instruments will be *lent* to such ships as the Board of Trade may select, on the captain or owner undertaking that the necessary observations shall be made, and that the register shall be properly kept, and with the instruments, returned to their agent on the return of the ship to a British port, at which the Board of Trade has established a meteorological agency. Also, that if they are not so returned or accounted for satisfactorily, the captain or the owner will be answerable for their value; and that, if broken, the damaged instrument shall be returned. Ships so provided will likewise be entitled to a copy of Lieutenant Maury's sailing directions and some charts.

18. Every vessel engaged in these observations is to be provided, either by the owner or captain, with at least one good chronometer, duly rated and compared; with a sextant, and with an azimuth compass fixed in a proper place, and which has its deviation determined before the ship proceeds to sea; and the captain of every ship so provided will undertake further to observe azimuths and amplitudes at sea, to record the variation observed in its proper column, with the direction of the ship's head at the same time; and always to set his course by the standard compass corrected for the observed variation.

19. These azimuth compasses may be either lent or sold to the owners or captains of ships, at reduced prices, like the other instruments, in cases where the ships have been duly selected and approved by the Board of Trade.

20. Captains offering to take charge of the instruments and to keep a Meteorological Register, will be required to satisfy the Board of Trade that they are competent to make the observations required, and to deduce the currents from them and the "dead reckoning."

21. On any affairs connected with the meteorological business undertaken by an agent, he will address his official correspondence to the Secretary of the Board of Trade.

22. The remuneration to the agent for such services will be at the rate of fifty shillings (2*l.* 10*s.*) for each vessel approved and supplied with instruments by the Board of Trade; which sum is to include the payment for any assistance that may be required by the agent.

23. The issue and return of instruments is to be considered as one complete transaction, whether the return be made by the same ship or by any other.

24. All captains receiving instruments, or undertaking to keep the Meteorological Register, will be expected to comply with the

conditions, and to be guided by the instructions which they contain.

CONDITIONS referred to in AGENTS' INSTRUCTIONS.—Par. 16.

To entitle the navigator to copies of such sheets of Maury's charts as relate to his intended voyage, and to a copy of Maury's Sailing Directions, he should be able to show that he is prepared to make the observations required of him, and is provided with necessary instruments; which should be, at least, a good compass, sextant, and chronometer; a mercurial barometer, and three air and water thermometers.

The United States government offers these charts and directions gratis to all navigators, on condition that they will continue to keep and forward abstract logs of their voyages.

The navigator who receives a copy of these charts and sailing directions is expected to give his co-operation by keeping an abstract log, not only for the voyage then intended, but for his subsequent voyages, unless informed that no further co-operation is desired.

Every navigator, who, after receiving a copy of these charts and sailing directions, fails to comply with the conditions, namely, to keep abstracts of his voyages in the prescribed form, and on his return to his own country, to transmit them to the person appointed to receive them, forfeits his claim to future publications.*

Meteorological Agency,

_____

SIR,

IN accordance with instructions from the Board of Trade, I am to acquaint you that a set of the under-mentioned instruments, or any less number of them, may be lent, or sold, to you, on the following conditions:

If lent, they are to be carefully used, and restored, in as good condition as may be practicable, to an Agent of the Board of Trade, at the return of your ship to a Port in Great Britain; unless, after communication with such Agent, and after his comparisons, you should be duly authorized to retain them.

Enclosed are letters, which you will have the goodness to sign, and return to me, upon receiving instruments, registers, charts, or books from the Board of Trade.

I am, Sir,
Your obedient servant,

_____ Agent.

Captain _____

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* Maury's Sailing Directions, 6th edition.

List of Prices (being the Cost Price, *average* Expense of Carriage, and Charge for Verification).

	£	s.	d.
Marine Barometer - - - - - -	3	10	0
Thermometer - - - - - -	0	7	0
Thermometer Stand or Screen - - -	0	10	0
Hydrometer (Glass) - - - - -	0	5	0
Azimuth Compass - - - - - -	6	10	0

One Set of Instruments consists of

1 Marine Barometer.
6 Thermometers.
1 Thermometer Stand or Screen.
4 Hydrometers (Glass).
1 Azimuth Compass.

Conditions.

To entitle the navigator to copies of such sheets of Maury's charts, as relate to his intended voyage, and to a copy of Maury's Sailing Directions, if in store, and to copies of such Board of Trade publications as may be available and suited to his objects, he should be able to show that he is prepared to make the observations required of him, and is provided with necessary instruments, which should be (at least) a good compass, sextant, and chronometer, a mercurial barometer, and three thermometers.

The navigator who receives a copy of such charts and directions is expected to give his assistance by keeping an abstract of his log, not only for the voyage then intended, but for subsequent voyages.

And a navigator who fails to comply with the conditions, namely, to keep abstracts of his voyages, in the prescribed form, and on his return to his own country to transmit them to the person appointed to receive them, will forfeit his claim to future publications, as well as to the loan of instruments.

Ship _____

_____

Sir,

I acknowledge the receipt of the _____

_____

enumerated below, and I promise to comply with the conditions stated in your letter of the _____

I am, Sir,
Your obedient servant,

_____

To _____

Agent for Meteorological Purposes. Ship _____

_____.

Articles supplied.	No. supplied.	Maker's Name.	Mark and Number of Instrument.	Condition.
Compasses - Barometers - Thermometers - Hydrometers -				
Registers - - Charts - - Books - -				

ADMIRALTY INSTRUCTIONS.

SIR, Board of Trade, January 6, 1855.

I AM requested by my Lords of the Privy Council for Trade to acknowledge the receipt of your letter of the 29th ult., transmitting for their consideration and suggestion a draft of the proposed instructions to Captain Fitzroy, as Chief of the Meteorological Department, and in reply I am to request you to inform the Lords Commissioners of the Admiralty that it appears to my Lords that some inconvenience might arise were Captain Fitzroy to receive separate Instructions for his guidance from two distinct departments, and they desire me to suggest for the consideration of the Lords Commissioners whether this object would not be answered equally well if their wishes with respect to his proceedings were addressed officially to my Lords, in order that they might be communicated by and through them to Captain Fitzroy.

(Signed) T. H. FARRER.

To the Secretary to the Admiralty.

SIR, Admiralty, January 11, 1855.

I AM commanded by my Lords Commissioners of the Admiralty to transmit to you the enclosed copy of their instructions to Captain Fitzroy, with reference to meteorological observations to be made on board Her Majesty's ships, and I am to request that the President of the Board of Trade will be pleased to communicate them to that officer in the manner he may deem most convenient.

I am, Sir,
Your obedient Servant,
(Signed) W. A. B. HAMILTON.

James Booth, Esq.,
Board of Trade.

SIR, Admiralty, Dec. 24, 1854.

THE Lords Commissioners of the Admiralty having, on the representation of the Royal Society, decided that Her Majesty's ships shall take a part in the extended series of meteorological observations to be made chiefly at sea, and it having been arranged between the President of the Board of Trade and the First Lord of the Admiralty that you should take charge of measures necessary to carry the above-mentioned observations into effect, both on board ships of war and merchant ships, I am commanded to acquaint you that you have been appointed by their Lordships to that duty, as far as relates to Her Majesty's ships, and that your appointment is to date from the 1st of August last.

War having, unhappily, broken out since the original proposal for such observations was made, it will not for the present be practicable to carry out the measure so extensively as was at first intended, but there are still many cases in which it may be effected, as on board the ships on the North American and West India station, the Brazils, the Coast of Africa, India, Australia, and the Pacific. You will therefore place yourself in communication with the Hydrographer to the Admiralty, and in conjunction with him, order the requisite standard instruments to be prepared, and when properly tested, to be sent out by any convenient and safe opportunity to those stations for distribution among the ships.

A copy of the form of register which was sanctioned in April last is sent herewith for your information; but it is the wish of their Lordships to act in concert as much as possible with the Board of Trade, so that the observations may be uniform throughout the Royal Navy and Mercantile Marine, so far as is consistent with the established regulations and the usual routine of duties in Her Majesty's Service.

A sufficient supply of the blank forms of register is to be sent to all ships and stations to which instruments are sent; and it may be desirable that they should be accompanied by explicit and detailed instructions for making observations, should it be considered that those already issued in the Admiralty Manual are not sufficiently comprehensive.

When the instruments, registers, and instructions are ready, their Lordships will issue the necessary orders to the fleet for the observations being regularly carried out whenever the more immediate duties of the public service admit of it. Meteorological observations are now being made, and have been made for some years past under the orders of the Admiralty, at Halifax, Bermuda, Valparaiso, Ascension, and at Trincomalee, Columbo, and Point de Galle in Ceylon, and the records are periodically transmitted to England: these registers you can have access to on application to the Hydrographer. It will be for you to consider

whether it is desirable to continue observations at those places, and if so, to ascertain whether the instruments by which they are made are equal to the standard barometers and thermometers which it is understood have been lately perfected, and if not, to exchange them, as opportunities may arise, for the improved instruments.

All registers received will in future be sent to you for examination and discussion. It will be a part of your duty also to examine all the "Remark Books" periodically transmitted to the Admiralty, and on all occasions that you obtain information which can be useful to the navigator, as with reference to winds, currents, soundings, &c., you will at once acquaint the Hydrographer, in order that it may be inserted in the charts and sailing directions issued by the Admiralty for the public benefit.

The vote sanctioned by Parliament in the Admiralty estimates for these purposes is 1,000*l.* a year, which is considered will be ample for all the requirements of the service, and you will be careful that the whole expenses connected with carrying out this measure shall not exceed that sum in any single year, without their Lordships' express sanction.

Captain Fitz-Roy, R. N., F.R.S.

LETTER to AUTHORITIES at HER MAJESTY'S DOCKYARDS.

Admiralty and Board of Trade,
Meteorological Office,

IN obedience to the orders of my Lords Commissioners of the Admiralty, (referring to their Lordships' Circular, No. 258, July 25, 1856,) I have the honour to send to you the articles specified on the other side.

I am,

Your obedient servant,

To

List.

Registers or Weather-books - - - -	
Barometers : Nos.	
Aneroid barometers : Nos.	
Thermometers : Nos.	
Hydrometers : Nos.	

Circular, No. 258.

Admiralty, July 25th, 1856.

Meteorological Observations.

Her Majesty's Government having undertaken to promote and take part in an extended system of meteorological observations at sea, and having caused the requisite instruments, forms of register, and instructions to be provided and placed at the principal sea ports of the United Kingdom for the use of the Mercantile Marine, the Lords Commissioners of the Admiralty direct that all captains and commanding officers of Her Majesty's ships will co-operate in this undertaking, whenever and as far as their respective opportunities and means will admit.

Standard barometers, tested thermometers, and registers, with the necessary instructions, will be supplied from Her Majesty's dockyards, in the usual manner, on demand. The observations are to be carefully made, and recorded in the mode pointed out in the instructions; and the registers, when filled up, are to be transmitted to the Admiralty through the same channels as the ship's log-books.

Stationary ships, or ships fitting out or re-fitting in a home port, where a regular series of meteorological observations is established, will not be required to make the above observations while remaining at such port.

This order does not affect Art. I., Sect. IX., Chapter V., of the Admiralty printed Instructions, which still remains in force.

By command of their Lordships,

R. Osborne.

To all Commanders-in-Chief, Captains, Commanders, and Commanding Officers of Her Majesty's Ships and Vessels.

N.B.—Screens or stands for thermometers may be obtained by application at the dockyards, or can be made on board according to the patterns at each depositary of instruments.

APPENDIX F.

Office Returns and Lists.

Return showing the Number of Books, Charts, and Instruments, &c. received at and issued from the Meteorological Department up to the 1st March 1857.

Received.				Articles.	Issued.			
1854-5.	1856.	1857 to March 1.	Total.		1854-5.	1856.	1857 to March 1.	Total.
11,022	300	200	11,522	Maury's Charts - -	3,696	905	136	4,737
300	—	—	300	Maury's Sailing Directions.	143	147	2	292
450	1,000	—	1,450	Board of Trade Meteorological Registers.	450	641	121	1,212
6,800	24,700	—	31,500	Board of Trade Wind Charts.	1,404	10,754	24	12,182
1,000	1,000	2,000	4,000	Blank Returns - -	400	300	200	900
	(Contracted for.)							
102	30	—	132	Compasses - - -	102	20	10	132
210	260	20	490	Barometers - -	206	126	24	356
1,340	1,320	240	2,900	Thermometers - -	1,290	498	174	1,962
1,340	600	160	2,100	Hydrometers - -	698	610	161	1,468
—	20	—	20	Aneroids - - -	—	20	—	20

Return showing the Number and Disposal of Instruments purchased by the Meteorological Department of the Board of Trade, with the number ordered, not yet delivered.

Board of Trade.				How disposed of.	Admiralty.			
Compasses.	Barometers.	Thermometers.	Hydrometers.		Aneroids.	Barometers.	Thermometers.	Hydrometers.
79	114	684	424	Sent afloat - - - - - -	7	91	336	198
49	68	554	443	Ready at Stations (including 30 Barometers repaired and re-issued).	13	46	180	251
1	13	—	—	Repairable - - - - - -	—	17	—	—
—	—	113	69	Condemned - - - - -	—	—	13	7
2	6	57	11	Sold - - - - - - -	—	—	—	—
1	1	25	65	Lost, or unaccounted for by Captains of Ships.	—	—	—	—
132	202	1,433	1,012	Total number disposed of - - -	20	154	529	456
(to the 1st January.)					(to the 1st March.)			
132	240	1,760	1,240	Total number contracted for to the 1st March.	20	250	1,140	860

List of Meteorological Agents.

Place.	Name.	Address.
England.		
Bristol	J. M. Hyde	1, Broad Quay.
Hull	Z. Scaping	Trinity House.
Liverpool	J. Hartnup	Observatory.
London	E. Hughes	Sailor's Home, Well Street.
Newcastle	T. Gray	Trinity House.
Plymouth	Captain W. Walker, R.N.	Shipping Office.
Southampton	J. R. Stebbing	47, High Street.
Scotland.		
Aberdeen	Rev. P. Robertson	7, Huntly Street.
Dundee	P. A. Feathers	26, Dock Street.
Glasgow	Captain A. Small	Local Marine Board.
Greenock	J. Gardner	Greenock (Optician).
Leith	J. Davidson	Local Marine Board.
Ireland.		
Belfast	F. M. Moore	114, High Street.
Cork	Commander T. Stuart, R.N.	Local Marine Board.
Dublin	Commander MacLean, R.N.	Local Marine Board.

Barometers supplied to H. M. Ships.

128 Standard Barometers have been supplied to H. M. Ships, or Stations, since 1854.

37 Standard Barometers have been returned from Ships paid off.

91 Standard Barometers are now in use on board H. M. Ships in commission.

Of the old Barometers (not standards, nor reliable) about one hundred have been withdrawn from H. M. Ships, and 58 of this number have been sold to opticians for the use of an inferior class of Ships, chiefly coasters. The rest will be similarly disposed of to the best bidders, their value being applied in payment for new instruments, of the authorized construction.

STATEMENT of SUMS voted by PARLIAMENT and ESTIMATE of the EXPENDITURE on account of the METEOROLOGICAL DEPARTMENT of the BOARD OF TRADE and ADMIRALTY, for "METEOROLOGICAL OBSERVATIONS AT SEA."

	1854–5.	1855–6.	1856–7.	Estimated 1857–8.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Amount of Vote for Board of Trade	3,200 0 0	3,200 0 0	3,200 0 0	3,200 0 0
EXPENDITURE.				
Salaries:				
Rear-Admiral FitzRoy	199 14 6	300 0 0	300 0 0	300 0 0
Mr. W. Pattrickson (*Salaries charged to, and paid out of, Board of Trade General Vote.*)	—	180 0 0	190 0 0	200 0 0
Mr. T. H. Babington (*Salaries charged to, and paid out of, Board of Trade General Vote.*)	—	81 0 7	88 15 0	100 0 0
Mr. F. R. Townsend (*Salaries charged to, and paid out of, Board of Trade General Vote.*)	—	81 0 1	90 0 0	110 0 0
Extra assistance in office	—	124 5 8	64 1 0	—
Port agencies and contingencies	51 2 1	383 8 4	568 15 6	500 0 0
Instruments, carriage, and repairs	682 0 0	1,411 18 0	653 1 9	1,000 0 0
Lithography (special)	—	503 18 0	466 7 0	800 0 0
Verification of instruments at Kew	—	113 10 0	46 2 0	190 0 0
Total amount expended	932 16 7	2,837 0 0*	2,098 7 3*	3,200 0 0
Amount of Vote for Admiralty	1,000 0 0	1,000 0 0	1,000 0 0	1,000 0 0
EXPENDITURE.				
Salary (Rear-Admiral FitzRoy)	200 0 0	300 0 0	300 0 0	300 0 0
Instruments, carriage, and repairs	—	670 19 2	625 15 1	580 0 0
Verification of instruments at Kew	—	79 10 0	50 15 0	70 0 0
Extra assistance in office	—	50 14 0	46 4 0	50 0 0
Total amount expended	200 0 0	1,101 3 2	1,022 14 1	1,000 0 0

* Exclusive of Salaries charged to Board of Trade general vote.

List of Office Books.

Contracts for instruments.
General registers of articles supplied.
Registers of Barometers.
" Thermometers "
" Hydrometers "
" Compasses "
" Books, Charts, &c. "
" Ships "
" Ships authorized to be supplied.
" Documents received.
" Letters received.
" Letters written.
" Requisitions to Admiralty.
" Deviations of compass.
" Instruments sold or returned.
" Orders or memoranda.
" Daily progress.

APPENDIX G.

Printed Forms.

Meteorological Register kept on board _____

DATE 18 ——		Latitude.		Longitude.		Currents and Temperature of Sea Surface.		Magnetic Variation.		Winds.		Barometer.	
Month, Day, and Moon.	Hours.	Observed.	D.R.	Observed.	D.R.	Direction. — Temperature by No.——.	Rate Daily.	Observed z. or m.*	Ship's Head.	Direction.	Force.	Height.	Attached Therm.
	2												
	4												
	6												
	8												
	9												
	10												
	Noon												
	2												
	3												
	4												
	6												
	8												
	10												
	Midt.												
	2												
	4												
	6												
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	9												
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	Noon												
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	10												
	Noon												
	2												
	3												
	4												
	6												
	8												
	10												
	Midt.												

1	2	3	4	5	6	7 and 20	8	9	9a	10	11	12	13

* z=azimuth. m=amplitude.

Captain _____ from _____ to _____

Hours.	Thermometer.		Clouds.			Weather.	REMARKS; including 19. State of the Sea.—21. Specific Gravity of Water.—22. Temperatures at depths :—and Deep Soundings (to be inserted at the nearest hour lines).
	Dry Bulb No.——.	Wet Bulb No.——.	Form or Character.	Amount 0—10.	Direction of Upper.	Fog, Rain, Snow, Hail, Thunder, Lightning, &c.	
2							
4							
6							
8							
9							
10							
NOON							
2							
3							
4							
6							
8							
10							
MIDT.							
2							
4							
6							
8							
9							
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NOON							
2							
3							
4							
6							
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MIDT.							
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4							
6							
8							
9							
10							
NOON							
2							
3							
4							
6							
8							
10							
MIDT.							
2 a	14	15	16	17	17 a	18 and 23	19 21 22 24*

* NOTE.—These numbers show columns of Brussels Conference Form.

METEOROLOGICAL AGENCY at _____

SHIPS proposed to be supplied by _____

Date.	Ship's Name.	Tons.	Description.	Of what Port.	Owner.	Captain.	Certificate Number.	Destination.

METEOROLOGICAL _____

Supplied by _____

Date.	To.	Conveyance.		No.	Distinguishing Mark, Number, &c.	Remarks.

METEOROLOGICAL AGENCY at _____

Instruments, Charts, and Books Supplied by _____

Date.	To what Ship.	Compasses.	Barometers.	Thermometers.	Hydrometers.	Charts.	Registers.	Directions, &c.

N.B.—The maker's name and mark, and the distinguishing numbers of the instruments supplied, are to be inserted on the Captain's Receipt, which is to accompany this Return.

METEOROLOGICAL AGENCY at _____

Ships supplied by _____

Date.	Ship's Name.	Tons.	Description.	Of what Port.	Owner.	Captain.	Certificate Number.	Destination.

METEOROLOGICAL AGENCY at _____

Instruments, Charts, and Books received in charge of _____

Date.	From	Compasses.		Barometers.		Thermometers.		Hydrometers.		Charts.	Registers.	Directions.
		No.	Condition.	No.	Condition.	No.	Condition.	No.	Condition.			
	In Charge											

METEOROLOGICAL AGENCY at _____

Cr. Contingent Expenses and Receipts by _____ *Dr.*

Date.	Paid.	£	s.	d.	Date.	Received.	£	s.	d.

Admiralty Instruments, &c.

Ready at Dockyards.	Aneroids	Barometers.	Thermometers.	Hydrometers.	Registers.					

Board of Trade Instruments, &c.

Ready at Agencies.	Compasses.	Barometers.	Thermometers.	Hydrometers.	Registers.					

Date when sent.	Names.	Instruments under Repair by									Date when expected.
Instruments, &c. ordered from											

RETURN of METEOROLOGICAL INSTRUMENTS and BOOKS at _____ dated _____ 18___.

(Transmitted the first day of each month.)

Maker's Name.	Mark and Number.	Received.		BAROMETERS.	Issued.		
		Date.	Whence.	Condition and Remarks.	Date.	Ship.	Captain.

N.B.—The serviceable Barometers should stand first in the list.

Initials _____

Maker's Name.	Mark and Number.	Received.		ANEROIDS.	Issued.		
		Date.	Whence.	Condition and Remarks.	Date.	Ship.	Captain.

—The serv iceable Aneroids should stand first in the list.

THERMOMETER SCREENS or STANDS.

Initials _____

Received.					THERMOMETERS.	Issued.				
Maker.	Mark.	Numbers.	Date.	Whence.	Condition.	Maker.	Mark.	Numbers.	Date.	Ship.

N.B.—The serviceable Thermometers should stand first in the list,—the sets having been completed, and corrections inserted from the boxes whence taken. *Initials*_____

Received.					HYDROMETERS.	Issued.				
Maker.	Mark.	Numbers.	Date.	Whence.	Condition.	Maker.	Mark.	Numbers.	Date.	Ship.

N.B.—The serviceable Hydrometers should stand first in the list,—the sets having been completed and corrections inserted from the boxes whence taken.

Received.			METEOROLOGICAL REGISTERS.	Issued.		
Number.	Date.	Whence.	Number.	Date.	Ship.	Commander.

(A.)

RETURN

OF

METEOROLOGICAL INSTRUMENTS, &c.

Dated _____

Signed _____

APPENDIX H.

Simultaneous Observations.

It has been desired that a great many observations should be compared throughout the British Islands (with their neighbouring coasts and seas), at certain remarkable periods, to obtain the means of delineating or mapping the atmosphere at successive times; and thence to deduce the order of those changes of wind and weather which affect navigation and fisheries especially, besides agriculture, health, and all outdoor occupations.

Such maps or charts might show the various horizontal or other currents of wind (existing within such an area) at one time, to which all other corresponding times should be reduced by allowing for the difference of longitude.

They might show the pressure and temperature of those currents and other facts, such as the presence of clouds, rain, lightning, &c. at their respective localities.

A sequence of such maps, compiled for special periods when changes have been most marked, would enable meteorologists to trace atmospheric waves as well as currents, both in plan and section, and would throw much light on meteorology.

Means might be taken, by circular letters, or otherwise, to request copies of such particular observations made between certain limits and dates, as might be specified in a general manner, and accompanied by a form for details.

Circular.*

Probably all persons who are interested in meteorology as a science, or in changes of wind and weather as practical matters affecting every-day life, have more or less noticed the remarkable changes of the last winter season.

The meteorological department of the Board of Trade is collecting facts in connection with such changes of weather and violent winds, with the view of ascertaining exactly where and when they occurred throughout a considerable area, including the British islands and adjacent localities.

This last winter has been selected as a portion of time within which certain sequences of simultaneous observations at a great many places may be collected, and their results arranged for publication, with particular advantage.

The direction and force of wind, nature and changes of weather, height of barometer, temperature of air, and moisture, are particularly desired, at whatever time actually observed, at sea or on land, between the meridians of thirty degrees west and thirty of east longitude, and between the parallels of forty degrees and sixty-seven of north latitude.

* Suggested, as suitable, in substance.

Such information is requested relating to any time between November last and the end of February.

The meteorological daily notices in "The Times" might be referred to as a suitable and general form: which might be amplified.

In all cases, the peculiarities and errors or corrections of instruments should be given, with the known or estimated height (saying which) of the barometer above the mean level of the sea, besides expressing whether the observations are given exactly as made or whether any and what corrections have been applied towards their reduction.

In addition to data corresponding to those in the daily tabular returns given by "The Times," the more numerous the exact observations and details that may be transmitted, the more valuable will be the communication.

Captains of ships within the specified area, during the months selected, are particularly requested to send in as many observations as their logs or registers contain, for comparison made with those at lighthouses, and with the numerous records now kept by private gentlemen, besides those of established observatories.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

REPORT

ON

MURRAIN IN HORNED CATTLE,

THE

PUBLIC SALE OF DISEASED ANIMALS,

AND THE

EFFECTS OF THE CONSUMPTION OF THEIR FLESH ON HUMAN HEALTH;

ADDRESSED TO

THE RIGHT HONOURABLE THE PRESIDENT OF THE GENERAL BOARD OF HEALTH.

BY

E. HEADLAM GREENHOW, M.D.

Licentiate of the Royal College of Physicians,
Lecturer on Public Health at St. Thomas's Hospital, and
Physician to the Western General Dispensary.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1857.

[74.

2233

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REPORT ON CATTLE MURRAIN.

To the Right Honourable W. MONSELL, M.P., President of the General Board of Health, &c. &c.

SIR, London, April 24, 1857.

INSTRUCTIONS FOR INQUIRY.

IN a letter of instructions from the General Board of Health, dated March 7th, 1857, my attention was specially directed to the following passages in a recent Report of Dr. Burdon Sanderson, Medical Officer of Health for the district of Paddington:*—"The Inspector of Nuisances has examined during the "last month all the cowsheds in the parish. He has ascertained "that 314 cows are at present kept in Paddington. These "are distributed among 27 cowkeepers. Many of the sheds "are in close proximity to inhabited dwellings. In a large "proportion, the drainage and ventilation are deficient, and "fatal disease has prevailed to a frightful extent among the "animals kept. No less than 19 per cent. of the whole num-"ber of cows have died in the last three months. In one case "all the cows have died."

"No sooner does a cow become attacked with the invariably "fatal pulmonary affection which is at present so prevalent in the "Metropolitan cowsheds, than it becomes the object of the "keeper, without delay, to dispose of it before the disease has "made sufficient progress to render the animal unmarketable. "It is then conveyed to one of the slaughter-houses, of which "there are several in various parts of London devoted to the "carrying on of this disreputable trade. From thence the meat "either finds its way into the market as such, being retailed for "the most part to the indigent classes, and in the lowest neigh-"bourhoods, or passes into the hands of the manufacturers of "saveloys and certain descriptions of sausages, much employed "as articles of food by the same description of consumers."

NATURE AND PURPOSE OF INQUIRY.

I was requested to make an investigation in reference to the facts here stated, and afterwards to ascertain whether similar disease had prevailed in other parts of the Metropolis. In reference to the allegation that diseased cattle are slaughtered, and their flesh sold for human food, I was instructed to collect evidence, both as to the extent of the practice adverted to, and as to any effects on human health which might have been observed to follow the consumption of such meat.

The other objects of my investigation were stated to be "to learn for practical purposes under what conditions the disease is rendered more or less fatal;" and in reference to cases which should come under my notice, I was specially to inquire,—1 to what extent the commencement and spread of the disease had

* Sanitary Report to the Vestry of Paddington for the year 1856, by J. Burdon Sanderson, M.D., L.R.C.P., Medical Officer of Health.

depended on infection; 2 to what extent the ventilation and cleanliness of cowsheds or the use of particular kinds of food or water, had influenced the frequency or the fatality of the attack; 3 whether any means of prevention or cure were considered by veterinary practitioners to be more successful than others; and 4 to note in the course of the inquiry any points that might seem of pathological interest as to the nature of the disease, and its affinities with infective disorders of the human subject.

Several days after the receipt of the above-recited instructions, a series of official Despatches, from Colonel Hodges, C.B., Her Majesty's Consul-General at Hamburg, dated 3rd June 1856 and 21st February 1857, with enclosures from the Vice-Consul at Lubeck, dated 30th May 1856 and 20th February 1857, and subsequently despatches from Her Majesty's Consuls at Warsaw and Koenigsberg, dated respectively March 9th and 11th, 1857, were forwarded to me from the General Board of Health, with instructions to direct my attention to the matters therein referred to. My investigation was thus extended to the inquiry, whether the disease reported to prevail among the horned cattle of London had been imported from abroad, and was identical with the murrain reported to be prevailing in Mecklenburg and other Continental States.

Nature of inquiry.

The inquiry entrusted to me was thus of a twofold character; its first and most important object being the investigation of a matter which, both for the already recited reasons, and on account of the possible relations between the causes of disease in cattle and in the human subject, was of intimate interest to the public health. Secondarily to this, the inquiry was important under an economical and agricultural aspect; supposing the murrain at present prevailing on the Continent to be both contagious and different from the disease recently existing in London. The possible introduction of a new murrain from abroad into the herds of this country was evidently a question of great importance alike to the consumer and producer of meat.

Proceedings.

On the receipt of my instructions, I proceeded without delay to investigate the question committed to me. Commencing with Paddington, I placed myself in communication with Dr. Sanderson, Medical Officer of Health, and with the Inspector of Nuisances for that district, and subsequently pursued my inquiries in Marylebone, St. Pancras, Holborn, Islington, Whitechapel, Limehouse, Shoreditch, and Walham Green. In the course of this inquiry I visited many of the cowsheds belonging to both large and small proprietors, and took evidence from the keepers and other persons in charge of the cattle. I also procured information personally, from Mr. Bark, Veterinary surgeon, one of the inspectors of cattle for the port of London; from Mr. Nice, Veterinary surgeon, Inspector of cattle at the Metropolitan Cattle Market in Copenhagen Fields; from other officers of the same establishment; from several dealers in cattle; from Mr. Fisher, inspector of meat and slaughter-houses for the City of London; and, from Mr. Pocklington, Inspector of Newgate Market. The Association of Metropolitan

Officers of Health having appointed a Committee in June 1856, to "inquire into the facts relating to the alleged sale of diseased "and unwholesome meat in the Metropolis, as well as the ill "effects arising therefrom," and a report of this Committee having been printed, I called upon Dr. Challice, the chairman, and upon several of the members of the Committee, for the purpose of obtaining such information as they might be able to favour me with in reference to the sale of the flesh of diseased animals, and the effect of the use of such meat on the human subject. Lastly, from Parliamentary and other public documents, and from the most reliable literary sources, English and foreign, I have endeavoured to obtain such additional information as could be procured without unduly delaying the presentation of my Report.

I now proceed to report the result of my investigations under the heads of,—

I.—The disease :

II.—The sale of diseased animals to be slaughtered for human food ; and

III.—The effects on human health of consuming the flesh of diseased animals.

Division of Report into heads.

I. *The disease.*—An "epidemic" disease—for notwithstanding that this word was originally applied only to diseases of the human subject, I may employ it, as one that is well understood, to designate the analogous diseases of cattle,—has recently prevailed, not only among the horned cattle of London, but in many other parts of England and on the Continent.

I. The Disease.

Simultaneous prevalence in England, and on the Continent.

A. *In England.* I have personally had the opportunity of learning the recent existence of such a disease in the vicinity of Manchester, and am informed that it has been prevalent in Bedfordshire, Buckinghamshire, Shropshire, Cheshire, and, I believe, more or less in most other counties of England. Mr. Radcliffe, M.R.C.S., of Bramley, near Leeds, says in a letter with which he has favoured me on this subject, that the same disease has frequently prevailed in that neighbourhood, although at the date of his communication it had ceased.

A. In England.

The disease referred to in Dr. Sanderson's Report to the Vestry of Paddington, and which is identical with that prevalent in other parts of the country, is commonly known among veterinary practitioners, graziers, and cowkeepers, by the name of "lung-disease." It is more scientifically called exudative pleuro-pneumonia by Professor Gluge, of Brussels, and is identical with the *Lungenseuche* or "pulmonary murrain" of German writers. In this country it is also frequently called "the new disease," to distinguish it from an eruptive disease that preceded it, popularly known as the "foot and tongue disease," and now commonly spoken of by cattle-keepers as the "old epidemic." The latter disease was characterized by apthous ulcerations of the mouth, lips, and nose, and by swelling of the fauces, causing a constant slavering or dribbling of frothy saliva ; by vesicles and ulcerations of the feet; and by pustules and ulcers of the teats, accompanied by inflammation and abscesses of the udders. This epidemic was

Identical with Lungenseuche or pulmonary murrain of German writers.

Preceded by an eruptive murrain.

the forerunner of the more serious and fatal pulmonary affection, much as influenza has occasionally preceded outbreaks of cholera and dysentery in the human subject.

First appearance of eruptive murrain.

The *eruptive disease* does not seem to have existed in England until 1839, and only to have become generally diffused in the course of the following year. It would appear to be contagious, but is now much less frequent than formerly. It has often been considered, but as will presently be seen incorrectly, as but a different stage or form of the disease, which, when it attacks the lungs, is called pleuro-pneumonia. Mr. Faussett, who has published a very interesting account of both diseases in the Dublin Medical Press,* considers the eruptive disease as only the primary stage of the pulmonary affection, which he calls the secondary distemper, and which he says follows the former at variable intervals. So far as his inquiries extended, he found the eruptive disease had, with a single exception, invariably preceded pleuro-pneumonia. The fact is unquestionable that both diseases have often co-existed in the same herd. It is equally true that the eruptive affection, which is a comparatively mild disease, very often occurs without being followed by pleuro-pneumonia, which, on the other hand, is very common in animals that have not suffered from the so-called primary distemper. Indeed, the supposed inter-relation of the two affections is unsupported either by satisfactory evidence or by pathological analogy.†

First appearance of pulmonary murrain.

The eruptive epidemic was followed, after an interval of two years, by an epidemic of *pleuro-pneumonia*, or, as I shall henceforth call it, *pulmonary murrain*, a disease which has been very destructive, and fatal, it is said, to upwards of 50 per cent. of the animals it attacks. Pulmonary murrain would seem never to have entirely disappeared since its first outbreak; for although it manifests itself from time to time more generally and in an epidemic form, it never fails to linger in several parts of the country during the intervals between its more extensive visitations. That it really is a disease new to the present generation is unquestionable. The principal English writers that I have consulted for the purpose of this inquiry, — Professor Simonds, of the Royal Veterinary College,‡ and Mr. George Waters, Jun., Member of the Royal Veterinary College, who wrote a prize essay on the subject,§—concur on this point. Their opinions are confirmed by my personal inquiries, for cow-keepers, graziers, and farmers, with whom I have conversed,

Pulmonary murrain a recent disease in England.

* Observations on the Epidemic Pleuro-pneumonia, or Secondary Distemper of Horned Cattle, by William Faussett, A.B., Licentiate of the Royal College of Surgeons, Ireland, Surgeon of Drumcondra and Richmond Dispensary.—Dublin Medical Press, vol. vi., page 390.

† Faussett, in Dublin Medical Press, vol. vi. p. 390. Report on the Epidemic among Cattle, by Professor Sewell, in Journal of Royal Agricultural Society, vol. ii. p. 119. Also, Report of the Census in Ireland, part 5, vol. i. p. 227.

‡ Lecture on the Anatomy, Physiology, and Pathology of the Organs of Respiration and Circulation, with especial reference to the Nature and Treatment of Pleuro-pneumonia in the Ox, published in Journal of the Royal Agricultural Society of England, vol. x. page 570.

§ Journal of the Royal Agricultural Society of England, vol. ix. p. 343.

assure me that they distinctly recollect the first appearance of the disease.

Pulmonary murrain prevailed in England about 1745–60.

There are, however, good reasons for supposing that a similar disease prevailed among the horned cattle of Britain about a century ago. Its invasion was then also heralded, although with a longer interval, by an eruptive disease similar to that which preceded the appearance of pulmonary murrain in 1841. Prior to its appearance in England, pulmonary murrain had prevailed extensively, and proved most destructive to the cattle on the Continent. More than 200,000 cattle are reported to have perished from the murrain in Holland in 1745, and more than 40,000 in Nottinghamshire in 1747, whilst in Cheshire 30,000 died in less than six months. Its importation into this country is attributed either to the introduction of two calves imported from Holland by a farmer at Poplar, or to the introduction of a parcel of distempered hides which had been ordered to be buried in Zealand, but were purchased by an English tanner. The evidence in favour of the importation of the murrain is, however, most inconclusive; although, supposing the disease to have been contagious as well as epidemic, it is impossible to deny the possibility of its having been imported. The destructive nature of the disorder attracted the attention of Government, and after a time orders were issued for the destruction of every animal that exhibited the slightest symptom of infection; the owner, of course, being remunerated for his loss. In the third year of the murrain no less than 80,000 cattle were thus destroyed, in addition to at least double the number that died of the disease. In the fourth year cattle were destroyed at the rate of 7,000 per month, until it was found that the farmers frequently concealed the cattle really suffering from murrain, and brought their otherwise diseased and old and worn-out cattle to be slaughtered, in order to obtain the allowance made by Government for the destruction of such as suffered from murrain. Amongst other measures adopted by Government to check the spread of the disease was the appointment of local Boards of Health, with power to cut off all communication between infected and healthy districts, and to superintend the slaughter and immediate burial of infected cattle. It appears very doubtful whether any of the measures resorted to had much influence over the extension or duration of the disease, which, after a time, became milder in character, and at length, about 1758, began very evidently to decline, although it did not altogether disappear until several years later.*

Ravages of the epidemic in 1745—7.

Supposed mode of importation into England in 1745.

Proceedings of the English Government to arrest the extension of the epidemic.

Spontaneous departure of the epidemic.

Pulmonary murrain not supposed to have been imported in 1841.

The introduction of pulmonary murrain into this country in 1841, is not usually attributed to contagion. Indeed, much

* The above account is chiefly compiled from contemporary authorities, particularly from the pamphlets of Dr. Brocklesby, Dr. Hird, Dr. Layard, and an anonymous treatise by a member of the Royal College of Physicians. Mr. Youatt gives an admirable history of this epidemic in his work on cattle, published under the superintendence of the Society for the Diffusion of Useful Knowledge.

doubt is expressed by many of the English cattle-keepers as to the possibility of its direct extension from animal to animal. Abroad it is universally considered as contagious, and its extension from place to place has been usually attributed to communication with infected cattle.* Upon the whole, perhaps, the weight of evidence is in favour of its possessing some infectious properties. Professor Simonds, who delivered a lecture on the subject before the Royal Agricultural Society,† expressly says that the disease was not introduced by direct importation, but considers it as of atmospheric origin, "and "caused by a destructive poison that has been wafted hither "through the medium of the air, as (he believes) has been the "case with that of Asiatic cholera, and similar pests." Little, however, is really known on the subject, for the unscientific and frequently ill-informed persons who have the management of horned cattle are evidently incompetent to form a clear judgment on a point which has caused so much controversy amongst the best-informed members of the medical profession; and it is most unusual for the dairymen of London to call in any regularly educated veterinary practitioner to their sick cattle, some nostrum vendor or other quack being at most resorted to. Thus, at least in the Metropolis, veterinary surgeons being rarely consulted for the diseases of cattle, the opportunities for studying these diseases unfortunately appear to be fewest at the fountain head of veterinary science, where, we may presume, they would be turned to the most profitable use. One fact, however, came out very clearly in the course of my inquiries. It is, that single cases rarely occur, but that when the disease appears among the cattle of a particular dairy, it is liable to attack several in succession. I found, moreover, that very often whilst some keepers had sustained a considerable loss, others in the immediate neighbourhood had altogether escaped, a fact which appears to be opposed to the view that this disease is caused by a general distemperature of the atmosphere. Whilst, however, on the one hand, this circumstance would seem to favour the supposition that the murrain spreads by contagion, it appears, on the other, that very often the animals attacked are at different portions of the establishment, and that of cows which live together in the same stall, inhale each other's breath, and are in constant contact with one another, one will suffer from the disease, whilst the other escapes it. Moreover, I was informed by more than one intelligent keeper that individual cows have continued to thrive, side by side with which a succession of two or three companions had fallen victims to the disorder. It would have been most

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* *See* Appendix, Numbers II., III., and IV., for the opinions of foreign veterinary authorities on the contagiousness and nature of pulmonary murrain. It is quite clear that some of these writers entertain a highly exaggerated opinion of the communicability of this disease. It is, for example, contrary alike to reason and fact to suppose the flesh of diseased animals to be a means of conveying the contagion.

† Journal of the Royal Agricultural Society, vol. x., pp. 599–606.

interesting if my investigations had enabled me to say whether the animals which have enjoyed this remarkable immunity had previously passed safely through the disease. Upon this head I could learn nothing certain. But I did learn that cows which have really recovered from the disease are considered secure from future attacks, and that animals which have remained in the sheds unscathed, whilst the disease has attacked their companions are believed to be seasoned, and on that account are highly esteemed.

Difference of opinion as to contagion.

As already stated, much contrariety of opinion prevails as to whether the disease be contagious. I met with only one person who thinks that the infection adheres to the building. By him I was informed that he has remarked a tendency of the disease to show itself in cattle placed in stalls from which diseased animals have already been removed. More careful observation would possibly suggest a different explanation of the circumstance, the correctness of which I do not doubt, for my informant was more than usually intelligent. All my informants concurred in asserting that animals which have been recently purchased or removed, are more liable to suffer from pulmonary murrain than such as have been some time in the sheds. This circumstance, perhaps, accounts for the belief so prevalent on the Continent that pulmonary murrain spreads chiefly by contagion,* an opinion very difficult either to confirm or disprove from an inquiry conducted only among cow-keepers in London, because there is here a constant introduction of fresh cows from the country to supply the place of such as becoming dry are sent to market. For example, the Prussian official reports† for 1852–3 state that pulmonary murrain occurs chiefly in the Rhenish provinces, where much cattle is imported from Holland, and attribute its prevalence to this fact, evidently considering contagion as the chief cause of the disease.

Recently purchased cattle most liable.

Pulmonary murrain sometimes developed spontaneously.

Although, as I have already said, pulmonary murrain sometimes arises from infection, it appears equally evident that, under favourable circumstances, it likewise originates spontaneously. More than one person assured me they could not trace its invasion of their stock to any extraneous source, and the German writers, who have devoted far more care to the philosophical investigation of cattle diseases than has been, perhaps, possible in this country, distinctly affirm its occasional spontaneous development.‡ In "An Account of the Epidemical Distemper" that prevailed among black cattle about the middle of last century, written by a member of the College of Physicians, whose description of the disease then prevailing exactly corresponds with that of the pulmonary murrain of our own times,§ it is distinctly stated that "the distemper has sprung up spon-

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* See Appendix, Numbers II., III., IV., and V.

† *Canstatt's Bericht*, 1855.

‡ Loc. citat. 1853 and 1855.

§ Account of the Present Epidemical Distemper amongst the Black Cattle, &c., by a Member of the College of Physicians. London, 1745, p. 12.

" taneously, about the same period of time, in many places " which are very distant from, and have no communication " with each other." The history of the outbreak of pulmonary murrain in Ireland in our own time also supports the view that this disease is frequently developed independently of intercourse with an infected source. According to a MS. communication to the Irish Census Commissioners, from Mr. Doyle, V.S., pulmonary murrain began, as early as 1840, in the vicinity of the metropolis, where it prevailed chiefly among milch cows. "As many as 40 per cent. were lost." The date of its first appearance in Ireland is, however, more usually fixed at a later period, although still so early, and probably so simultaneously with its appearance in England as to render the transmission of the murrain from this country most improbable. It seems to have appeared amongst cattle in the county of Cork in August 1841; in Meath also in 1841, where it, however, prevailed to a greater extent in the years 1842, 1843, and 1844, continued very general for seven or eight years longer, and is reported by Thomas Barnes, Esq., of Moynalty, still to have appeared occasionally so lately as 1855. The murrain appeared in Roscommon in 1842, and in Galway and Limerick in 1843, where it continued to prevail from time to time so lately as the years 1855 and 1856.

Appeared in Ireland simultaneously with its outbreak in England.

Preceded in Ireland by eruptive murrain.

In Ireland as in England, the outbreak of pulmonary murrain was preceded by the eruptive epidemic, or, as it is termed in the Report on the Census in Ireland for the year 1851, pustular disease. By the same authority it is stated that the pustular murrain was highly contagious, and "it was remarked that cattle " were seldom attacked a second time with the malady: although " it gave them no immunity from the lung distemper."* The mortality in Ireland from pulmonary murrain was very great. It was variously estimated in different localities at from 10 to 20 and even 40 per cent. One dairyman near Dublin lost 413 cows from the disease in four months.

Pulmonary murrain among the horned cattle of London.

I have found it impossible to form an accurate estimate either of the extent to which pulmonary murrain has recently prevailed among the horned cattle of the metropolis, or of the mortality it has occasioned. At the time of my inquiry the disease was by no means prevalent. Out of many hundred cattle in the sheds of persons from whom I sought information, only a few isolated and by no means severe examples of the disease were to be found. The chief prevalence of the complaint had been about the close of last year and the beginning of the present; just, in fact, at the period referred to by Dr. Sanderson.† Mr. Stedman,

Period of prevalence.

* The Census of Ireland for the year 1851, Part 5, vol. i. pp. 222, 226, 227, 229, 236, and 357.

† As Dr. Sanderson explained to me, the assertions in his report that the disease is " invariably fatal," and that " no less than 19 per cent. of the whole number of cows " have died in the last three months," require to be read in conjunction with the statement that the animals are disposed of as soon as they show symptoms of illness, and " before the disease has made sufficient progress to render them unmarketable." It was his meaning that this number died of the disorder or were slaughtered on account of it.

a large cow-keeper in the east of London, whose stock of cows varies from 150 to 200 in number, lost 27 cows from disease in the month of January last. Nineteen of these suffered from pulmonary murrain, the remaining eight from a disease that presented features not unlike a disease that will hereafter be described under the name of *dysenteric murrain*. The disease was perfectly new to Mr. Stedman, who says that, although occupied about cows all his life, he never saw anything like it before. The symptoms were profuse diarrhœa, of a kind so rapidly exhaustive as to have proved fatal in most cases within twelve hours. Of the eight animals attacked, only one survived to the third day. In several cases cows supposed to have been in good health at night were found dead in their stalls on the following morning, having in the meantime been profusely scoured. The disease was fatal in every instance, and with one exception was confined to recently purchased animals. On examination of the bodies after death the flesh was very dark coloured, being represented by Mr. Stedman as black. There have been no cases of the disease since January, neither could I learn that the same disease has existed in any other dairy. It is to be regretted that a careful *post mortem* inspection of some of the bodies was not made by a veterinary surgeon, for it is impossible to determine whether the disease was akin to dysenteric murrain, or whether it might not be the consequence of poison. Mr. Stedman, however, informed me that he had no reason to suspect the animals had been poisoned, but, on the contrary, said that he believed them to have died of illness.

Cases resembling dysenteric murrain.

Pulmonary murrain is certainly not invariably fatal, for I saw cows in several dairies that had gone safely through the disease and were again in a thriving condition. Mr. Stedman showed me four that were still ill. Three of them were recovering. The fourth appeared in an unpromising state, its breathing being laborious, its skin firmly attached to the subjacent tissues, and its coat rough and staring. I was informed by several keepers that they highly prized animals which had passed successfully through the disease, as they considered them to be secure from any future attack. One keeper, Mr. George Field, of Upper Gower Mews, showed me three animals that had recovered, and observed that he thought cows that have had a slight attack of the disorder thrive better afterwards.

Pulmonary murrain not always fatal.

The mortality of pulmonary murrain, when permitted to run its course, with or without treatment, has been variously estimated. Probably about one half the fully-developed cases prove fatal, but I am disposed to think that many animals pass through the disease in a mild form, unnoticed by the keepers, and without the development of the more prominent and alarming symptoms. Young animals it is said much more frequently recover than old ones, to whom the disease is mostly fatal, if allowed to run its course.

Mortality of pulmonary murrain.

Animals in poor condition, and recently calved cows, or cows iving a large yield of milk, are the most liable to the disease.

Predisposing causes.

Hence it is found that breeding suffer more largely than fattening stock. According to evidence collected by the Epidemiological Society, and arranged by Mr. Gabriel, the comparative liability is as two to one. M. Delafond indeed reckons over-feeding and too high a condition as among the causes of pulmonary murrain, but he conjoins with these the effect of over-lactation, to which, in common with English observers, he attaches an important share in the causation of this disease.* But by far the most powerful determining cause is removal to a fresh locality. My informants, without exception, said that recently purchased animals are more liable to the disease than those which have been some time in the sheds. Several cow-keepers that have farms to which they remove their cattle in the summer asserted that removing the animals from the town-sheds to the pasture, and *vice versâ*, has the same effect.

Removal of cattle apparently a frequent cause.

Perhaps, one reason of the greater liability of recently-purchased animals to suffer from pulmonary murrain is, that besides being frequently out of condition, they are very often fatigued and disordered by the journey to market. One person, whose cattle had hitherto escaped the disease, attributed the immunity to the fact of his going personally into the country to purchase cows, and so avoiding all unnecessary fatigue in their transit to the sheds. This liability of animals to suffer from "lung disease," after removal to a fresh locality, is so apparent, that several large cow-keepers who have farms a few miles from London, or who rent portions of the Essex marshes for the use of their cattle during the summer months, expressed an intention of not sending their cows out of the town-sheds in future. A prevalent supposition that cattle fed on marshes are more liable to suffer from pulmonary murrain than those fed on dry pastures, seems to be not altogether unfounded.

Cows usually sold as soon as they cease to yield milk.

One reason which rendered it impossible to estimate the extent of the disease, even approximatively, was, that with few exceptions, the cow-keepers of the metropolis send their cows to market as soon as they cease to supply a profitable yield of milk, from whatever cause this may arise. A sudden diminution of milk is usually one of the early symptoms of pulmonary murrain. As animals when attacked by this disease, besides becoming unprofitable as milch cows, lose condition very rapidly, it is now the common practice to send them to market at once, if in tolerable condition. Putting the chance of death out of the question, some considerable time must usually elapse before a cow attacked by this disease can again become profitable as a milker; and in the meantime its value as meat is rapidly depreciated by emaciation. The loss of value during the acute stage of the disease was estimated at 6*l.* per week by more than one of my informants. It would, however, be very inaccurate to assert that most of the animals sent to market by the cowkeepers of London are disposed of because of disease; the truth

* Loc. citat. ch. vi.

being that a much larger number are sold on account of the natural cessation of the secretion of milk, simultaneously with which the animals usually fatten. The larger proprietors occasionally keep some of their best cows for several years, selling others, however, as soon as they become dry. In the smaller dairies it is unusual to keep cows beyond a few months. From nine to ten months may be assumed as about the average period during which cows are profitable as milkers in the cow-sheds of London. This time accords pretty nearly with that stated as usual in the country, Mr. Stephens, in his Book of the Farm, mentioning ten months as a common period.*

Pulmonary murrain arises both spontaneously and by contagion.

I have already said that pulmonary murrain is thought to be contagious, although not very highly so, and that it is likewise capable of spontaneous development. This view agrees pretty exactly with that of the best continental writers. Bornhausen and Hausmann† both admit the spontaneous development of the disease. Janich‡, on the other hand, observed it to spread rapidly from house to house in Bohemia in 1844 and 1851. M. Delafond, who has devoted much attention to the investigation of this disease, has cited an irrefragable amount of evidence in support of its being at least occasionally propagated by contagion. A large majority of the correspondents of the Epidemiological Society, who reside in all parts of the kingdom, concur in expressing the same opinion. The contagion is reported to be conveyed by the air expired from the lungs of animals suffering from the disease. It is probably not communicable in this manner beyond a distance of eighty paces, and is distinctly stated by Delafond to be incapable of being wafted further by currents of air.§ It is also said to be communicated to healthy animals by the saliva, and by the secretion from the nostrils of those that are diseased.‖

The period of incubation, or the interval that elapses between exposure to the contagion and the appearance of the disease,

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* The following extract from Mr. Stephens' Book of the Farm, a well-known and much-esteemed work, shows the practice of selling cows as soon as they become dry, to be a common custom in dairies in or near towns, and one by no means peculiar to London:—"The cows of a farm in the immediate neighbourhood of towns, and those "in the town's dairies themselves, are fattened when the milk leaves them, and not "allowed to breed again,—the time in which they would remain dry being regarded "as lost." Vol. 1, p. 272. See also Cattle, their Breed, Management, and Diseases, by William Youatt, published under the superintendence of the Society for the Diffusion of Useful Knowledge, p. 262.

† *Canstatt's Bericht*, 1853.

‡ Loc. cit.

§ Delafond believes the contagion to be communicable by means of the bodies of animals that have suffered from the disorder. He cites no satisfactory evidence in support of the supposition, and, indeed, very candidly admits that the facts adduced by him require precision.—*Traité sur la Peripneumonie Contagieuse*, p. 188.

‖ Since the above was in type I have perused the report of a French scientific commission appointed to investigate pulmonary murrain of which M. Magendie was president. The report was drawn up by M. H. Bouley, clinical professor at the Imperial Veterinary School of Alfort, and is countersigned by M. Magendie. The commission instituted a series of costly experiments to investigate the contagiousness of pleuro-pneumonia, the result of which is summed up as follows:—

1. The pleuro-pneumonia of horned cattle is transmissible from diseased to healthy animals of the same species living together in the same stables.

[2. All

Period of incubation.

is variously stated. The discrepancies of authors on this part of the subject, together with the fact that periods of incubation of extraordinary length are spoken of, must be regarded as throwing doubts on the infectiousness of the disease. Mr. Gabriel, who drew up a very brief report, based on the replies from upwards of three hundred veterinary surgeons to queries issued by the Epidemiological Society, says that the period of incubation is uniformly stated to be between three and four weeks. Some of my informants represented it to be as long as six or seven weeks. These periods accord pretty accurately with the facts recorded by Mr. Waters in his prize essay, wherein he mentions the appearance of the disease at periods varying from a fortnight to six weeks after the supposed introduction of tainted animals into a herd. Delafond* calculates the length of time between exposure to contagion and the manifestation of the early symptoms at from thirty to forty days, but says it oftener falls within than exceeds this period. Hausmann,† on the other hand, says the period of incubation may extend to three months.

Causes of spontaneous development.

The causes which produce the spontaneous development of pulmonary murrain are said to be variable and intemperate weather, and hot, crowded, and foul stables. M. Delafond enumerates cold, and especially the respiration of a cold, moist, foggy atmosphere, such as prevails in moist pastures, particularly in spring and autumn, as amongst the causes which generate the complaint independently of contagion. He also attaches much importance to the character of the breed, asserting that a liability to the disease is capable of hereditary transmission. This view harmonises well with a statement made by a friend of mine who has a large farm in Shropshire, that the disease has never been known to prevail among the Hereford breed of cattle, excepting when there was distinct evidence of contagion. In Mr. Gabriel's report to the Epidemiological Society, it is said, "the weather at the majority "of the outbreaks is stated to have been wet, cold, and gloomy; "in a few instances only the disease appearing in fine weather." The members of a Belgian commission appointed to investigate the prophylactic value of inoculation in pulmonary murrain report, that the disease is most prevalent between the months of October and April, and that it rages with the greatest intensity in October and November.

Influence of breed and of season.

2. All animals exposed to the contagion do not contract pleuro-pneumonia. Some of those exposed altogether resist the influence of the contagion; others undergo only a mild and brief indisposition.

3. Of animals which contract the disease, some recover, and regain after their recovery all the external appearances of good health; others die.

4. Animals which present only slight symptoms of indisposition after exposure to the contagion appear to be thereby protected from any future attack of pleuro-pneumonia.

5. Animals that have undergone an attack of pleuro-pneumonia seem to be insusceptible of a second seizure.—"*Rapport Général des Travaux de la Commission Scientifique instituée près le Ministère de l'Agriculture, du Commerce, et des Travaux Publics pour l'étude de la Péripneumonie Epizootique du Gros Bétail.*" Paris, 1854. p. 75.

* Loc. cit.

† *Canstatt's Bericht*, 1853.

Ventilation and cleanliness of cow-sheds.

Defective ventilation and cleanliness do not appear to have materially influenced the outbreak or extent of the disease in the dairies of London. From the prevalent custom of sending the animals to market on the first appearance of illness, it is impossible to say what effect these circumstances had on the intensity or mortality of the complaint. The disease had, I was told, been most severe in the best-ventilated and one of the cleanest sheds in Paddington; but the ventilation was excessive so that the animals were kept in a perpetual current of cold air. The cow-houses are usually kept as clean as possible internally, being commonly cleansed and washed out twice daily, and the walls lime-washed or whitened several times in the year. The drainage was found to be usually defective, and sometimes the adjoining yards were in a most filthy condition. The arrangements for ventilation were in several cases most excellent; ventilating shafts being carried up perpendicularly through the roof into the open air, thus allowing free exit for the pulmonary and other emanations; fresh air being, at the same time, admitted into the houses by lateral windows. More frequently, the only mode of egress for the exhalations is through the tiles of the roof, which are usually so arranged as to protect the animals from the weather, and yet, being laid without lime, to leave numerous interstices for the passage of air. In all cases there were lateral windows or openings for the admission of air, although, as might be expected, there was much variation in the character and perfectness of the arrangements. An ammoniacal odour was only observable in a few instances. The animals are usually packed pretty closely, two being placed together in each stall, both to economise space, and also to maintain the temperature of the building, for the yield of milk is supposed to be larger and richer when the animals are kept warm. Although I could obtain no positive data as to the influence of ventilation on the health of the animals, it appears that the effect on cattle of inhaling an atmosphere charged with particles of dust is similar to that produced on man, for dusty hay and chaff were said to be aggravating causes of pulmonary murrain. This, however, might fairly have been predicted.

Management of Cattle in the London cow-sheds.

Upon the whole, the cows in the London cow-sheds were said, and indeed appeared, to be healthy. Notwithstanding their unnatural mode of life, many of them being kept tied to their stalls for several months together, they are usually in very good condition. On the other hand, there are many dairymen who have farms, to which their cows are sent in the summer season, so that they are only kept in town during the winter. In other cases, the dairyman has the opportunity of turning them into a yard for a short time daily. It did not, however, appear that either of these classes had enjoyed any remarkable immunity from the disease. Amongst other establishments that I visited was one in Goodman's Fields, to which I was taken by Mr. Liddle, Medical Officer of Health for Whitechapel. The cows, ten in number, are kept in a cellar beneath the footway

Cows kept in a cellar.

of the street. The cellar was clean, well whitewashed, lighted with gas, and ventilated by means of grates in the pavement. The animals appeared in good health, and I was assured by the proprietor he had been most fortunate, not only having had no disease among his cattle during ten years, but having usually sold them at a remunerative price when the milk dried up.

Upon the whole, the disease seems most capricious. I have been told of farms that have enjoyed a complete immunity from the disease whilst it raged on adjoining farms, said to be in all respects similarly circumstanced, both as to soil, management, and the kind of cattle. A cow-keeper at Walham Green, who lost almost the entire stock in 1850, has since suffered little or no loss by the disease. Pulmonary murrain does not appear to be more prevalent in London than in the country. Persons who have farms at different places a few miles from London, and beyond the London atmosphere, have informed me the losses by illness on their farms were quite as large, in some cases larger, than that sustained in the town sheds. Mr. George Field, to whom I have already referred, said he has sustained a heavier loss from this disease amongst the cattle in his fields at Neesdon than among those in his cow-sheds in Hopkins-street, situated in one of the densest parts of the metropolis, and not very far from the centre of the portion of St. James', Westminster, in which the memorable outbreak of cholera occurred in the autumn of 1854. Similar evidence was given by other keepers.

Losses equal in town and country.

Food and Water.

The kind of food seems to have had no influence in the causation or aggravation of the disease, animals fed on grass being equally liable with those fed on grain, mangel-wurzel, and hay or straw. Well-fed animals in good condition are, however, universally allowed to be the least liable to suffer. M. Delafond* mentions the drinking of very cold water in winter and of stagnant water in summer as occasional causes of the disease. I obtained no evidence to show that the kind of water used by the animals had anything to do either with exciting or aggravating the disorder.

Treatment.

As already observed, veterinary practitioners are rarely consulted in London for the diseases of cattle, the most usual treatment being to slaughter the animals for food as soon as they manifest unequivocal signs of illness. There are, nevertheless, some vendors of nostrums who have obtained a reputation amongst cowkeepers for the success of their treatment of this disease. Any attempt to attain possession of their presumed secret would of course have been fruitless, and from what I could learn, it does not appear that these quacks are really a whit more successful than the regular farriers. Bleeding, setons in the dewlap, mercurials, and purgatives have been recommended for the cure of the disease by one set of veterinary practitioners, but apparently with scanty benefit. By others a stimulating mode of treatment has been

* Loc. cit.

advised. According to information obtained from Germany, chalybeate medicines, and particularly the sulphate of iron, given to the extent of half an ounce in the day, are the only remedies which have there been attended with any success. There too, as here, it is however most usual to slaughter the animals for human food on the first appearance of disease. Upon the whole, therefore, my inquiry whether any mode of cure is considered by veterinary practitioners to be more successful than others gave me only negative results.

Inoculation as a preventative of pulmonary murrain.

Various hygienic precautions have been tried for the prevention of the disease, but hitherto with only indifferent success. The only plan that is said to have been serviceable as a preventative is inoculation, but upon grounds so questionable that, had it not been still practised in this country, and referred to in various public despatches and documents placed in my hands, I should scarcely have considered it necessary to devote to it more than a very brief notice. The practice of inoculation is adopted in at least one of the establishments I visited, and is there said to be attended with complete success. As, however, I found several dairies in the same neighbourhood in which there had been no disease, notwithstanding the neglect of inoculation, no real evidence in support of the custom is afforded by the alleged immunity.

Inoculation first tried in England in the 18th century.

Inoculation was recommended and said to be successfully practised* by Sir W. St. Quentin, the Rev. Dr. Fountayne, Dean of York, and other gentlemen, against the disease that ravaged the herds of this country about a century since. The inoculation was performed with matter taken from the running of the mouth, nose, and eyes. As already said, there would seem to have been two different diseases running on side by side among the herds of this country at that period. The cases described by Dr. Layard seem more nearly to resemble the "*Rinderpest*" or steppe murrain than pulmonary murrain, which was then also prevailing in other parts of the country. The plan which thus originated here was also tried with doubtful success in Holland, perhaps because due discrimination was not exercised in selecting the right kind of cases for its employment. Steppe murrain is said to occur only once to the same animal, and to be communicable by means of inoculation. It is therefore quite possible that the practice of inoculation might be successful in steppe murrain, and yet fail in pulmonary murrain. Inoculation could hardly be expected to answer in any but a specific febrile disease. It is, to say the least, more certain of steppe murrain than of pulmonary murrain, that it is of this description. I therefore suspect that the successful cases, if any were really successful, were of this kind, and not of that in which inoculation has recently been tried.

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* An Essay on the Nature, Causes, and Cure of the Contagious Disease among the Horned Cattle in these Kingdoms. By Daniel Peter Layard, M.D., Member of the Royal College of Physicians in London, and of the Royal Society. London, 1757. P. 104.

Inoculation as recommended by Dr. Willems of Hasselt.

The practice of inoculation in the ox was re-introduced in 1852 as a preventive of pulmonary murrain, by Dr. Willems, a physician at Hasselt in Belgium. The matter employed by Dr. Willems consists of the liquid pressed from the lungs of an animal recently slaughtered, or of one that has died of this disease. The matter for inoculation should, according to Dr. Willems, be taken from an animal suffering from the early stage of the disease, and in preference from a portion of lung in which the disease is least advanced, for the use of liquid from the lungs in an advanced stage of disease is, he says, liable to be succeeded by more violent local symptoms. The operation is performed upon the tail, near its extremity, and is followed after an uncertain interval, varying from a few days to thirty, by tenderness, swelling, inflammation, and induration of the wound and its neighbourhood. Sloughing and mortification are very common consequences of the operation, and frequently a portion, sometimes the whole, of the tail is lost. In rarer, but still not very unfrequent instances, the sloughing extends to the perineum and adjoining organs, producing death after a period of much suffering unless the animal be timely slaughtered. The local consequences of inoculation have occasionally lasted two or three months. Dr. Willems asserts that an excessively abundant exudation, analogous to that hereafter to be described as occurring in the lungs of diseased animals, takes place in the swollen region immediately around the point of inoculation.

Local consequences of inoculation.

The liquid obtained from the lungs of oxen affected with pulmonary murrain is considered by the advocates of inoculation as a specific virus (probably meaning specific chemical). They assert that neither the blood nor any other matter taken from diseased animals, with the exception of this liquid, is capable of exciting the true local phenomena, when employed to inoculate healthy ones. The liquid employed for inoculation is considered by Dr. Willems to set up a "dynamical" action*; being absorbed into the circulation, it acts upon and modifies it in such a manner as to influence the whole system and render the animal unapt to contract pulmonary murrain. The bovine race, it is said, are alone susceptible of being influenced by this virus; animals of other races, when inoculated with the same matter, experiencing no specific effect. Not only, it is asserted, does this mode of inoculation preserve animals from pulmonary murrain, but they are said also to fatten better in an epidemic atmosphere than animals that have not been inoculated. The consequences of inoculation are limited to the neighbourhood of the operation, death being caused, when this is fatal, by the extension of the local disease to adjoining organs. *In no case have the lungs been found diseased after death caused by inoculation.* "Morbid degenera-" tion," say the Dutch Commissioners who were appointed to

* The justice of this view is at least very questionable, It is more than possible that the so-called "virus" possesses no properties but those of common inflammatory products.

investigate this subject, "has never been observed in the pectoral "cavity or in the lungs, but as yet only in the belly."*

The use of inoculation not based on scientific principles.

Unfortunately, the great success reported by Dr. Willems to have followed his own trials of inoculation, has not been attained by others. Probably the failure of the scheme might have been predicted, for, admitting pulmonary murrain to be contagious, it is contrary to all analogy that the specific virus of the disease (allowing the fluid squeezed out of the diseased lungs to be such) should not exert its influence on those organs which are the normal seat of the natural disease. Whether a person inhales the small-pox contagion with his breath, or has it inserted into the surface of his body by means of a lancet, is immaterial as regards the seat of the consequent local affection. In either case the characteristic symptoms of small-pox present themselves on the skin. The same rule applies in other contagious diseases. It also applies to common as well as to morbid poisons. However introduced, arsenic affects the stomach and cantharides the kidney. It might reasonably be expected to hold good in pulmonary murrain, if the inoculation really produced any specific constitutional effect apart from the local injury sustained. It is admitted that when pulmonary murrain does occur after what is termed a successful inoculation, its course and severity are uninfluenced by the preceding inoculation. This circumstance is altogether at variance with the pathological fact upon which inoculation is based, namely, that the organism having once passed through certain contagious diseases, either is thereby rendered altogether insusceptible of being affected by the contagion in future, or subsequently undergoes the disease in a very mitigated and comparatively harmless manner. Isolated and rare exceptions only occur to this rule in individuals whose system is either naturally or accidentally very prone to the influence of morbid poisons. In truth, however, if inoculation has ever been of use in pulmonary murrain, its action has resembled that of an issue,† and the immunity produced by it may be compared to the alleged immunity of persons who have chronic discharges from the contagion of plague.

Official investigations into the value of inoculation.

The suggestion of inoculation for the prevention of a disease that had nearly decimated the herds it attacked, was thought so important that several continental governments appointed special commissions to investigate the subject. The reports of two of these commissions—the Dutch and Belgian—have been presented to the House of Commons by command of Her Majesty, in pursuance of an address of the House, dated December 6th, 1852. Notwithstanding the brief time that had then elapsed since the introduction of inoculation as a preventive of pulmonary mur-

* See papers respecting Pleuro-pneumonia in cattle and abstract of experiments made by Dr. Willems of Hasselt, *presented to the House of Commons by command of Her Majesty, in pursuance of their Address of December* 6, 1852, pp. 30, 31, 49, and 58 ; also further papers respecting Pleuro-pneumonia in Cattle, p. 112.

† Issues and setons have frequently been recommended as preventive or curative of pulmonary murrain.

rain, these reports contain sufficient evidence to render the value of the operation at least very doubtful. Dr. Willems had stated in his memorial to the Minister of the Interior, that out of 108 animals inoculated by him in his father's stables, not one had taken pulmonary murrain, whilst of 50 beasts, that not having been inoculated were placed in the same stables, 17 speedily became diseased.* Pulmonary murrain, he adds, which had never been absent from the stables since 1836, was then banished. At a later period, (26th October, 1852,) Dr. Willems, in a letter to the "Central "Commission of Pleuro-pneumonia," states that with few exceptions all the beasts of the bovine race in Hasselt had been inoculated, and adds that the disease was almost unknown, excepting as a sad remembrance, a circumstance which he attributes altogether to inoculation.

Report of Belgian Commissioners.

It is reported by the Belgian commissioners that, exclusive of the 108 beasts belonging to his father, Dr. Willems had before the end of 1852 operated on 1,034 animals of the bovine race. Six of these subsequently contracted pulmonary murrain, but four of them had been unsuccessfully inoculated; in one the success had been doubtful, and in the remaining animal alone had the operation produced its proper result.† This success was, however, more apparent than real, for a deputation, sent by the commissioners to examine into the condition of the animals at Hasselt, reports that the cattle there, whether inoculated or uninoculated, were generally in the most perfect health, the only cases of pulmonary murrain seen by the delegates having been three inoculated animals, in some dark unclean stables abounding in putrid emanations, and an inoculated heifer at the slaughter-house.‡ Elsewhere M. Maris, one of the veterinary surgeons at Hasselt, reports that it was "impossible to establish any distinction "between the inoculated animals and those that had not been "submitted to the preservative."§ Moreover, no case of pulmonary murrain had occurred at M. A. Stellingwerff's stables during the summer of 1852, where inoculation had not been practised, and the disease had on former occasions been absent from both the fattening and lean stock for periods varying from six months to two years. Considering therefore, that, Dr. Willems' private experiments excepted, inoculation had then only been tried for six or seven months, the assertion that the disease had diminished in Hasselt in consequence of inoculation seems but very ill founded.

Unsatisfactory results of inoculation.

On the other hand, both the Dutch and Belgian Commissioners report the occurrence of many cases of pulmonary murrain in inoculated animals. Sixteen out of 132 successfully inoculated animals mentioned in the Dutch Report were subsequently attacked by the disease at periods of time varying from eleven to fifty-one days after the operation. Exclusive of those

* Papers respecting Pleuro-pneumonia in Cattle, pp. 18–30.
† Further papers respecting Pleuro-pneumonia in Cattle, p. 145.
‡ Loc. cit. pp. 152, 154.
§ Loc. cit. p. 153.

in which the disease showed itself anterior to the fifteenth day, and may therefore be presumed to have been infected prior to being inoculated, seven of these animals, or more than five per cent. of the whole number inoculated, fell victims to the epidemic within eight weeks of the operation, being just one half the estimated average annual loss anterior to the introduction of the so-called preservative. To this loss should be added that of ten animals which died in consequence of the local mischief occasioned by the operation, making the total loss in the animals inoculated under the auspices of the Dutch commissioners larger than the average annual loss among uninoculated animals.* The Belgian commissioners report that out of 4,324 animals that had been successfully inoculated, eighty-six died from the consequences of the inoculation, and seventy-three subsequently contracted pulmonary murrain. Excluding eighteen doubtful cases, the loss by pulmonary murrain in beasts inoculated with unequivocal success is reduced to fifty-five. This, however, is the best aspect of the case, for not to mention that 2,451 of the inoculations were performed in Hasselt or the neighbourhood, where the disease had evidently subsided prior to the commencement of the observations, more than one-half the animals inoculated were fattening for the shambles, in which condition they are generally admitted to be less liable to the disease.†

Mr. Simonds' experiments.

Nor does the result of some experiments performed in this country by Mr. Simonds, at the request of the Royal Agricultural Society, afford any support to the opinion that inoculation either produces the specific disease, or serves as a preservative from pulmonary murrain. Mr. Simonds found the local result of the inoculation to be only "ordinary inflammation, advancing with "greater or less rapidity to suppuration." He also observed the same local consequences to arise from repeated inoculations on the same subject; to be produced by medicinal irritants almost as readily as by the liquid taken from the lungs of diseased animals; and to follow the inoculation of sheep, pigs, and a dog, as well as that of horned cattle. The last fact, especially, is directly opposed to Dr. Willems' assertion, that the bovine race alone are influenced by the so-called virus, and also to his belief that the local disease produced by inoculation is of a specific character; for pulmonary murrain is generally considered as peculiar to the ox. Finally, out of a herd of 100 animals belonging to Mr. Paget, of Ruddington Grange, near Nottingham, that were inoculated under Mr. Simonds' directions, six that had been successfully inoculated became the subjects of pulmonary murrain within a few months.‡

Reports of other observers.

The doubts as to the value of inoculation that arise from a consideration of these facts, are strengthened by the reports

* Loc. cit. p. 126.

† Further papers respecting pleuro-pneumonia in cattle, pp. 140 and 141.

‡ Second Report on the Prevention of Pleuro-Pneumonia in Cattle by Inoculation. Journal of the Royal Agricultural Society, vol. xiv.

of Prussian and other continental observers. Hildebrand relates that eleven cows which had been inoculated in the tail subsequently died of pulmonary murrain; and Schüger, who had previously been in favour of the operation, says he saw cows die of pulmonary murrain seven months after having been successfully inoculated. Bretsch reports that of 159 cattle inoculated in December 1853, in some of which the operation was afterwards performed a second time, 31 died of pulmonary murrain between the end of February and the middle of June. The most favourable report, with the exception of Dr. Willems' that I have seen, is that of Van Dommelen, who inoculated 211 head of cattle, 132 of which stood in stalls where the murrain prevailed. Eleven of these afterwards died of the murrain, but the remainder continued healthy, although some of them were under observation for six months.

Conclusions of Belgian Commissioners.

I cannot better or more impartially sum up the foregoing evidence on the practice of inoculation for pulmonary murrain, than by adopting the cautious conclusions of the Belgian Commissioners,—"that inoculation with the liquid extracted from a "lung hepatised in consequence of pluro-pneumonia, is not an "absolute preservative against that disease; that the phenomena succeeding inoculation may occur several times upon the "same animal, whether it has or has not been affected with "exudative pleuro-pneumonia; and that the two affections may "go on simultaneously in one and the same individual." Admitting the correctness of these conclusions, inoculation, for the pathological reasons already assigned, and on account of the suffering it causes the animals, and the losses that are its immediate consequence when performed strictly in accordance with the practice of Dr. Willems, is at once a cruel and a useless proceeding.*

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* I had not the opportunity of seeing the report of the French scientific commission appointed to investigate the epidemic pleuro-pneumonia of horned cattle until after this report was in type. The conclusions of the Commissioners on the subject of inoculation agree in many respects with the opinions at which I have arrived, but they believe inoculation to possess some protective influence. The general résumé of their experience is printed in the Appendix (No. V.). The numbers seem far too small to justify conclusions, and no evidence is given of subsequent protection. The following are their conclusions on the subject of inoculation:—

1. Inoculation with the liquid taken from the lungs of an ox suffering from pleuro-pneumonia does not transmit to healthy animals of the same species a similar disease, at least in situation, to that whence the matter of inoculation proceeded.
2. The appreciable phenomena consequent upon inoculation are, in a certain number of inoculated animals, those of a slight local inflammation confined to the seat of the operation; in other cases they are those of a severe diffuse inflammation accompanied by general illness proportioned to the intensity of the local disorder, complicated sometimes with gangrenous mischief which occasionally causes death.
3. Inoculation, with the liquid taken from the lungs of an animal ill with pleuro-pneumonia possesses a preservative power; it invests the organism of most of the animals on which it is practised with an immunity which protects them against the contagion of the disease for a time the duration of which is as yet uncertain, but which in the experiments of the commission has not been less than six months.

The result of the two sets of experiments made by the Commissioners may be thus briefly summed up, the number upon which the experiments were tried being first brought

Analogies of pulmonary murrain with human diseases.

Pulmonary murrain has resemblances with both hooping-cough and influenza in the human subject. Like hooping-cough, it is at once epidemic and contagious. Pathologically it has a much closer affinity with influenza than hooping-cough, but differs from both in its inflammatory character; inflammation, which appears to be inseparable from pulmonary murrain, being only a complication in these human diseases. Its visitations, like those of influenza, are uncertain, and not immediately referable to any definite condition of atmosphere. Pulmonary murrain does not strike the cattle of a whole district as influenza does the human inhabitants of a considerable area; but attacks by a succession of local outbreaks. Its re-appearance in the present century, after an absence of nearly a century from the herds of this country, is a most important fact in its history, particularly when considered in conjunction with the occurrence of cholera in the human subject, and of the potato disease and other blights among vegetables, at nearly the same period of time. Blight and murrain and pestilence have often been associated as calamities. Perhaps they are not altogether unallied in their causes. Whether the epidemic influences from which man suffers act also on the lower animals and on the vegetable kingdom, and whether the causes of their epidemic diseases affect ourselves, are as yet unopened, but nevertheless important, fields of inquiry. It is indeed true that the materials for solving these questions are at present most scanty, but the study of human with animal and vegetable epidemic diseases could not fail to elucidate many still obscure facts, and to throw important light on the pathology, not only of man, but likewise of those animals whose well-doing is intimately associated with his material prosperity.

Coincidence in time with human and vegetable epidemics.

Possible co-relations of blight, murrain, and pestilence.

Possible causes of pulmonary murrain.

Pulmonary murrain may possibly be dependent on some obscure circumstances of breed, feeding, or management. It can scarcely be referred exclusively to any atmospherical cause, for it would probably then have been a frequent and well-known visitor, instead of being, as it is asserted, an entirely new disease. In the absence of any specific data upon which to found an accurate opinion on this interesting topic, I can thus only suggest probabilities as aids to other inquirers, by whom they may either be negatived or confirmed. Unfortunately a subject of such paramount interest, especially to the agricultural class, appears to

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brought into correspondence by assuming them to have been 100 in each case; but the real numbers having been 46 for the trial by contagion, and 54 for that by inoculation. Of the 100 animals supposed to have been exposed to contagion by residence in the same stables with other animals suffering from pleuro-pneumonia, 54·34 either did not suffer at all, or suffered from the disease in a very benignant form. The remaining 45·65 * suffered more or less severely. Of these, whilst 36·95 recovered, 8·69 died. Of the 100 animals supposed to have been inoculated, the operation was benignant in 61·11, and more or less injurious in 38·88. Of the last number, 27·77 recovered, and 11.11 died. In other words, of 100 animals exposed to contagion, 8·69 would die, according to the result of the experiments of the commission, whilst 11·11 would die out of the same number of inoculated animals.—"*Rapport Général des Travaux de la Commission Scientifique institués près le Ministère de l'Agriculture, du Commerce et des Travaux Publics pour l'étude de la Péripneumonie Epizootique du Gros Bétail*, pp. 78–80."

* The figures are quoted correctly from p. 80 of the French report.

have hitherto had few investigators in this country, for I have been unable to meet with any special treatise on this kind of cattle disease in the English language, excepting such as were written by members of the medical profession in the last century.

Its pathology.

Whether pulmonary murrain be or be not the consequence of a special poison—and I will not stay to speculate upon such uncertain ground—its local consequences are those of inflammation. The inflammation is not of a very acute character, in this respect preserving the analogy already drawn between pulmonary murrain and influenza.* It has been correctly described by Mr. Faussett, M.R.C.S.I.† as an inflammation affecting both the lungs and pleuræ; as a peculiar inflammatory affection of the lungs and pleuræ by Mr. Jekyll, V.S.‡; and also by Mr. Waters, V.S., in a prize essay § presented to the Royal Agricultural Society. To Mr. Waters' essay I beg especially to refer, as it contains a most excellent account of the morbid anatomy of the disease, partly drawn up by Dr. Fisher, Downing Professor of Medicine in the University of Cambridge.

Appearances after death.

The lungs of animals that have suffered from pulmonary murrain present an appearance after death very different from any thing witnessed in the human subject. The diseased portion is much increased both in volume and weight, and on being cut into presents a marbled appearance. It is necessary for the right comprehension of this peculiarity to explain that, whilst the essential structure of the lungs in the ox is similar to that of the same organs in man and the higher animals, the clusters of air cells which form what are termed lobules are, in the ox, more loosely tied together by cellular tissue. There is also a greater abundance of the connecting cellular tissue forming partitions, or interlobular septa. These partitions are continuous with the cellular layer of the pleura or membrane covering the organ, and by means of the smooth glistening surface of which it glides without inconvenience, during respiration, over the similar membrane covering the sides of the chest.

Peculiar structure of the lung in the ox.

Morbid anatomy.

The consequence of this loose connection between the different portions of the lung is, that the plastic deposit poured out in consequence of inflammation, distends the loose cellular tissue that forms the partitions between the separate lobules of the organ, and thus produces the characteristic marbled appearance when the lungs are cut into. On examining the chest of an animal that has suffered from pulmonary murrain, the lungs are often found to be adherent to the sides of the chest, in consequence of the effusion of plastic lymph into the pleural cavity, by which the inner surfaces of the pleura, which ought to glide freely over each other, are glued together. The pleura, where free, is usually covered with a more or less extensive

* Mr. Simonds, lecturer on cattle pathology at the Royal Veterinary College, indeed, says that pulmonary murrain approaches nearer to a dropsical than an inflammatory disease, an opinion the reason of which it is difficult to understand. *See* Journal of the Royal Agricultural Society, vol. x. pp. 606, 607.

† Dublin Medical Press, vol. vi. p. 390.

‡ Veterinary Record, vol. ii. p. 304.

§ Journal of the Royal Agricultural Society, vol. ix.—pp. 346—53.

layer of the same effused lymph. This false membrane, as it is technically called, is sometimes of considerable thickness, and may be stripped off in considerable portions, which present the appearance of white skin. A considerable quantity of liquid, in which lumps of the same plastic lymph are floating, is very often found in the cavity of the chest. I am told the quantity of the liquid sometimes amounts to several gallons. The increased bulk of the lung itself, especially when conjoined with the liquid effusion, distends the diseased side of the chest, so as materially to increase its circumference.

Comparative weight of lungs in healthy and diseased cattle.

The weight of diseased lungs is frequently increased to 20, 30, and it is even said to 40 or 50 pounds. The following are the weights of some diseased and healthy lungs that were taken, at my request, under the inspection of Mr. Fisher, inspector of meat for the City of London. The two lungs of a healthy Norfolk ox, whose entire carcase weighed 100 stones, weighed eight pounds. Those of a healthy Dutch cow, whose entire weight was 70 stones, weighed nine pounds. In a Suffolk cow, with diseased lung, whose whole weight was 45 stones, the left lung was found to weigh 26 pounds; the right, and it may be presumed tolerably healthy, lung only weighed five pounds. So solid does the diseased portion of lung become that it sinks in water.

Characteristic appearance of diseased lung.

On cutting across an affected lung, the diseased portion presents a solid flesh-like appearance, all visible trace of the air-cells and smaller tubes being obliterated. This solid portion is intersected by white bands formed by the plastic effusion into the interlobular partitions; and is sometimes more or less abruptly bounded by these partitions, a comparatively healthy portion still pervious to air being found on one side of some of these bands, whilst a solid and impervious portion of lung exists on the opposite side. The irregular spaces of lung-substance that lie between the white interlobular bands are variously tinged of a dark mahogany red, brighter red, and sometimes pale red colour; the colour being mostly uniform in the same interspace, but differing much in adjoining spaces. The colour depends partly upon the stage and intensity of the disease, and is caused by the copious effusion of blood corpuscles. Assisted by my friend and colleague, Dr. Coote, I made a microscopical examination of portions of diseased lungs from two separate animals. The appearances presented were similar to what is found in ordinary pleuro-pneumonia. On washing away the blood corpuscles, which so obscured the view as to prevent anything else being seen, the lung-tissue presented the appearance of an amorphous granular mass traversed in all directions by bands of elastic fibres. This granular mass was soluble in acetic acid. Imbedded in this mass, or lying on its surface, were various bodies, viz., the red cells of the blood; cells from the surface of the bronchial mucous membrane in various stages of fatty degeneration; free fat and probably other granules; small masses of coagulated fibrin; and the same masses deeply coloured of a red, brown, or black tint, by

Microscopical appearances.

effused colouring matter of the blood. An examination of the pleura; of the false membrane that covered it; and of the yellowish white bands formed by the thickened interlobular partitions, in an early stage of the disease, seemed to show that the inflammation, commencing in the pleura, had subsequently extended by continuity along the interlobular divisions to the interior of the lung. The inflammatory deposit by which the interlobular partitions were also thickened showed no signs of organisation, and disappeared almost entirely on the addition of acetic acid.

Morbid anatomy in an advanced stage of disease.

In a more advanced stage of disease, the deposit in the lungs is found to be softening down and separating from the adjoining healthier tissue at the thickened bands of intersection. In other cases it becomes semi-friable. It is said that abscesses of the lung are an occasional consequence of pulmonary murrain, but I have met with nothing of the kind, in several examinations of lungs at different stages of the disease, perhaps because of the prevalent practise of slaughtering the animals for food as soon as they become diseased. Other changes that occur secondarily to the more characteristic consequences of the disease, are emphysema and the plugging up of many of the smaller tubes with dense muro-purulent secretion. The bronchial mucus membrane is also usually more or less inflamed, sometimes most extensively, and is said occasionally to throw out a plastic deposit analogous to the false membrane of croup in the human subject. The complaint is said by M. Delafond most frequently to commence simultaneously in the bronchial membrane, the lungs, and the pleura, but occasionally in any one of these parts, from which it extends so as to implicate the whole. I have reason to think that it sometimes commences in the pleura, and have little doubt M. Delafond is right in saying the bronchial membrane is also occasionally the earliest seat of the disease. The morbid anatomy of pulmonary murrain is almost exactly that of inflammation of the lungs and their lining and investing membranes in the human subject, modified by the anatomical peculiarities of the ox tribe.

Diarrhœa and the morbid changes with which it is associated.

Diarrhœa frequently sets in towards the close of pulmonary murrain, and proves rapidly fatal. On examining the intestines, but especially the small intestines, in such cases the mucous membrane is found covered with a copious secretion of adherent whitish mucus, on removing which by the free use of a stream of water, the membrane itself is observed to be injected and reddened in patches.

Reasons why symptomatology not investigated.

I have considered it unnecessary to enter into the subject of symptomatology, as its investigation was not a necessary part of the inquiry entrusted to me. I felt, moreover, that the symptoms of the disease could only be adequately described by a veterinary surgeon accustomed to study and treat the diseases of horned cattle. Nevertheless, to render the history of the disease contained in this report as complete as I could, I have printed Mr. Waters' account of the symptoms of pulmonary murrain

in the Appendix, where will likewise be found official reports on the same disease from three foreign veterinary practitioners, forwarded to the Earl of Clarendon by Col. Hodges, C.B., Her Majesty's Consul-General at Hamburg, and from Vice-Consuls Iven and Bird, of Kiel and Flensburg.*

B. *On Continent.*

B. *On Continent.* From a Despatch, dated 3rd June 1856, addressed by Col. Hodges, C.B., Her Majesty's Consul-General at Hamburg, to the Right Honourable the Earl of Clarendon, enclosing a Despatch from Her Majesty's Vice-Consul at Lubeck, it appears that the same disease which has recently been prevailing among the horned cattle of London, and other parts of Great Britain, has also prevailed in Mecklenburg Strelitz and Mecklenburg Schwerin. In a senatorial decree published by the Lubeck Government, forbidding the importation of horned cattle into the Lubeck territory, "unless they are certified by the competent authorities "to be entirely free from the disease," this complaint is called *Lungenseuche*, and no doubt correctly so, for the nature and distinctive character of the several diseases to which horned cattle are subject are much better understood in Germany than here.

1. PULMONARY MURRAIN.

Same disease as recently in England.

Has been prevailing in Mecklenburg.

In a second Consular Despatch to the Earl of Clarendon on the same subject, also enclosing a despatch, dated 21st February 1857, from the English Vice-Consul at Lubeck, Colonel Hodges announces the re-appearance of the murrain in Mecklenburg, and the renewal of the decree against the importation of cattle from the infected district into the territory of Lubeck, unless they are "accompanied by satisfactory certificates of their being "free from disease." By favour of Mr. Gebhardt, one of the chief consignees of foreign cattle sent to the London market from the north of Europe, I have seen a private letter, dated 7th March 1857, from Mr. Fred. Janssen, the lately deceased British Consul at Tonning, in which it is said that pulmonary murrain had shown itself some months since on several farms in Holstein, and chiefly in Dittemarsch, but that the spread of the disease had been checked by the slaughter of about 200 head of cattle. Notwithstanding this, I am informed by the same authority that the Danish Government had forbidden the importation of cattle between the Duchies of Schleswig and Holstein,† lest pulmonary murrain should thereby be conveyed into the former mentioned territory, which, although it has suffered severely from the murrain on former occasions, is at present believed to be free from disease. More recent accounts mention the existence of pulmonary murrain at Altona during the whole of last year, and in Saxony and Central

Precautions of the Lubeck Government.

Recent prevalence of pulmonary murrain in Holstein.

Precautions of Danish Government.

* Appendix, Numbers I., II., III., and IV.

† The correctness of this information has since been confirmed by the transmission of the following extract from the Hamburg "Nachrichten" of 21 March 1857 to the Earl of Clarendon by Colonel Hodges, C.B. :—"As several cases of a dangerous pul-"monary disease among the horned cattle still occur at various places within the "Duchy of Holstein, and as the measures directed to be taken in the notification of "the 28th of July last have proved insufficient, the importation of horned cattle from "the Duchy of Holstein into the Duchy of Schleswig is prohibited till further notice."

Prevalence of pulmonary murrain in other Continental States.

Germany for many years. It has prevailed in the neighbourhood of Altona on many occasions, and is supposed to have been invariably imported thither from abroad, usually through Hamburg. On one occasion, the disease is said to have been conveyed by means of a butcher, who, passing from place to place for the purchase of cattle, carried the contagion with him. I have learnt, from a private but reliable source, that the same disease has lately prevailed among the horned cattle in Sweden; and M. Delafond, Professor in the Imperial Veterinary School of Alfort, in a Memoir on this disease, published several years ago, says, that it then existed extensively in France, where it produced a considerable mortality.* If, therefore, we accept the correctness of the official accounts, confirmed as they are in every important particular by such other information as I have been able to obtain, the disease that has been prevailing in those districts of northern Germany, from which the chief importations of cattle into England take place, is identically the same as the pulmonary murrain which during the last sixteen or seventeen years has never been entirely absent from the herds and dairies of Great Britain and Ireland.

Additional precautions to prevent the importation of diseased animals not at present requisite.

The importance of this fact can scarcely be over estimated. It proves that, for the present at least, it is unnecessary to employ any additional restrictions to prevent the admission of diseased cattle from abroad. As nearly one-fifth of the horned cattle sold in the Metropolitan Cattle Market during the years 1855 and 1856 has consisted of animals imported from the Continent, this is of great consequence in an economical point of view.† Even if pulmonary murrain were propagated exclusively by contagion, any attempt to exclude from this country a disease which has already been existing here for many years, by means of prohibitory or quarantine regulations, must be futile. That it does not extend itself exclusively by contagion, but that it is frequently developed spontaneously, is the all but unanimous opinion of the most competent observers both at home and abroad, an opinion which is supported by my own investigations.‡

Precautions adopted by the Board of Customs against the importation of diseased animals.

But, in fact, every reasonable precaution to exclude diseased animals is already in operation. The Commissioners of Her Majesty's Customs have appointed duly qualified veterinary surgeons, at the chief ports of importation, to examine all cattle coming from foreign ports previous to their admission into this country; and where no permanent inspector has been appointed, the collector for the port is authorized to employ a veterinary surgeon to make the inspection, which is directed to be done as soon as possible after the arrival of a vessel on board of which there are any cattle. By printed instructions of 24th December

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* *Traité sur la Maladie de Poitrine du gros Bétail connue sous le nom de Péripneumonie contagieuse*, par O. Delafond, Professeur à l'Ecole royale veterinaire d'Alfort, &c. p. vi. Paris, 1844.

† See a return of the number of beasts exposed for sale at the Metropolitan Cattle Market in 1855 and 1856. Appendix, No. VII.

‡ *Canstatt's Bericht*, 1855. Delafond, *loc. cit.*, ch. vi.

1856, dated from the Custom House, London, it is directed that, *Instructions to veterinary inspectors.*
" after the cattle, sheep, lambs, or pigs have been landed, they are
" to be kept in charge until each animal has undergone a careful
" examination, and if found free from disease the whole are to be
" passed immediately ; but in the event of any disease being found
" to exist, such of them as may be so diseased are to be immediately
" killed, if the same be considered necessary by the veterinary
" surgeon ; and if upon a post-mortem examination of such
" cattle, sheep, lambs, or pigs, the same be found fit for human
" consumption, they, and the rest of the importation, are to be
" delivered to the owner or owners thereof; but should any of
" those so examined be unfit for such purpose, and the disease be
" of an epidemic or contagious character, they are to be buried,
" or effectually destroyed in the presence of an officer, and the
" remainder of the importation detained for further examination
" so long as the veterinary surgeon may deem necessary."* That these instructions have been most carefully attended to in the port of London there can be no doubt ; for remonstrances respecting the stringent character of the regulations in force have been made by the importers of cattle, both to the Board of Trade and the Commissioners of Customs. The carefulness with which the *Careful nature of inspection.* inspection is conducted is also confirmed by the assertion made to me by Mr. Nice, V.S., Inspector of live cattle at the Metropolitan Cattle Market, that he has not found occasion to seize or detain, on account of disease, a single animal among the many thousands of foreign horned cattle sent for sale to that market.

Besides the pulmonary murrain which, as already shown, has *Other kinds of murrain.* been prevalent in several countries of Northern Europe, contemporaneously with its existence in the cow-sheds of the metropolis, and among the herds and dairies of other parts of this country, two other diseases, are reported to be at present prevailing on the Continent. To these diseases, of which the one is of a contagious, the other of an epidemic nature, it is now necessary to refer. Both in some of the official accounts and by writers for the public journals in this country, these diseases have been confounded with each other, and with pulmonary murrain. Hence, probably, one cause of the exaggerated alarm that has been evinced lest a new, highly contagious, and fatal murrain should be introduced among our herds by means of the cattle imported from abroad. To the first of these diseases, which is in Germany called the *Rinderpest*, I shall apply the term Steppe Murrain, by which also it is known in that country. The other I shall refer to under the name of Dysenteric Murrain.

Steppe murrain is spontaneously developed only in Bess- 2. Steppe Murrain or *Rinderpest.*
arabia, Podolia, and other provinces of Southern Russia.† From

* See appendix, numbers IX. and X.

† The best continental authors, both of the last and present century, are unanimous in the belief that steppe murrain is only developed spontaneously in those countries, and among cattle of the Podolian or steppe breed. Ramazzini (De Contagiosa Epidemia quæ in Patavino Agro et tota fere Veneta Ditione Bovis irrepsit) attributes the appearance of the disease in Italy early in the 18th century to its introduction by means of a diseased animal imported from Dalmatia. Lancisi and Vicq-d'-Azyr

these it is rarely absent, and thence it spreads by contagion frequently into Poland, and occasionally into Austria and Prussia. Official Despatches, having reference to this form of murrain, from B. General Mansfield, Her Majesty's Consul at Warsaw, and from Mr. Consul Hertslet, of Koenigsberg, dated respectively March 19th, 1857, and March 11th, 1857, have been transmitted to me from the General Board of Health. I have also carefully examined a number of despatches and documents on the same subject at the Foreign Office and Board of Trade, to which I have been allowed access by the respective authorities of these departments. Very stringent regulations for the exclusion of this formidable murrain from the territories of Austria and Prussia have long existed. Until lately, the Russian authorities have not taken any measures to prevent the extension of the malady, which has therefore often committed the most formidable ravages among the herds of Russian Poland. Energetic measures, similar to those in force in the adjoining states, have now, however, been adopted by the Russo-Polish authorities. According to a recent return, 20,000 animals have already been slaughtered in accordance with a decree, published on May 9th, 1856, ordering the indiscriminate slaughter of all beasts that should exhibit any symptoms of the disease.

Adoption of precautions by the Russo-Polish Government.

Consular reports of its prevalence in Russian Poland and on the Prussian borders.

In B. Gen. Mansfield's Despatch, the disease is said to be still prevalent in Russian Poland, "though not, as far as he can understand, so much so as it was during the autumn." The disease, he adds, originally comes from the Steppes of the Ukraine, whence vast numbers of cattle are annually driven westward. Mr. Consul Hertslet reports that rumours of the existence of a murrain or cattle plague in Volhynia and Podolia have been current since 1854, and that the disease having gradually advanced in a northerly and westerly direction, had at length reached the immediate neighbourhood of the Prussian frontiers at Kowno and Tauroggen. The disease had not passed into the Prussian territories at the date of his despatch; but a later report says that it has now entered EAST PRUSSIA, having reached the village of *Meldiglanken, near Lansargen*, a place on the Prussian side of the frontier between Tilsit and Tauroggen. In a despatch, dated April 4th, 1857, Lord Bloomfield, Her Majesty's Ambassador at the Court of Prussia, reports that the steppe murrain has been imported into SILESIA by means of some cattle from Galicia. The disease has thus far only manifested itself at two points in the regencies of *Breslau* and *Oppeln*, and has, in fact, been confined to the oxen of the infected herd. The whole of the infected cattle, as well as all such as had come in contact with them, were immediately slaughtered, and the most

Steppe murrain imported into Silesia, and East Prussia.

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agree in referring the introduction of the murrain into Western Europe to contagion. M. Renault, director of the Imperial Veterinary School of Alfort, has fully examined this question in a recently published pamphlet (*Le typhus contagieux des bêtes bovines peut-il naître spontanément sur les animaux de l'espèce bovine étrangers à la race des steppes?* Paris, 1856). I had not the opportunity of examining M. Renault's work until this report was in the press; but the conclusion at which he has arrived, after many years of study, and a careful examination of the public documents of different European states, entirely accords with the result of my own investigations.

active measures adopted to prevent the further extension of the disease. "Judging from the experience of last year, there is every "reason to hope that its propagation will be prevented and its "extinction secured."*

Precautions adopted by Prussian and Austrian authorities.

According to Mr. Consul Hertslet's dispatch, the Prussian government so long ago as the years 1855 and 1856 had taken great precautions to secure the exclusion of the murrain. Not only had parties of military been detached to all the points of egress from Poland below Thorn, but the importation of hides, calf skins, wool, rags, and other articles likely to have been in any way connected with cattle, was prohibited, and all persons suspected of having transactions with cattle were forbidden to cross the border. Similar precautions are employed to exclude the murrain from the Austrian provinces that adjoin the infected provinces of Russia and Poland, the infected animals being killed as soon as they show any symptoms of the disease, and all cattle that have been in contact with them being placed in the most rigid quarantine.

Former existence of steppe murrain in England.

Steppe murrain probably existed in this country about the middle of last century, side by side with pulmonary murrain; for whilst some of the descriptions of the disease then prevalent very exactly accord with the symptoms of pulmonary murrain, as that disease presents itself now, other accounts agree more nearly with the description of steppe murrain given by continental writers of the present day.†

Nature of steppe murrain or Rinderpest.

Steppe Murrain or *Rinderpest* is described as a febrile disease analogous to continued fever in the human subject, but incommunicable to man or to other animals. It is preceded by a period of incubation, during which, however, an experienced observer will, it is said, be able to detect the approaching disease; runs through a definite course; and is accompanied at first by constipation, which usually in the last stage of the disorder gives place to choleraic diarrhœa. The preliminary or incubative period of the disease is said to last about seven days.

Spreads by contagion.

The spread of this disease beyond the steppe country is believed to be exclusively by means of contagion.‡ Official Austrian documents say that it frequently visits the eastern provinces of Austria, being conveyed thither either from Podolia and Volhynia into Gallicia, or from Bessarabia through Moldavia and Wallachia

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* May 12th. This expression of hope has been fully justified by the result, for the active measures adopted by the authorities have effectually checked the disease at all these places.

† The description both of the symptoms and post mortem appearances of the disease observed by the physician, already quoted at p. 13 of this Report, exactly coincide with pulmonary murrain as it is seen at the present day. The descriptions by Dr. Layard of the disease he saw at Godmanchester, and by M. Blondet of the similar disease then prevalent in France, are almost identical with that now given of *Rinderpest* by the best German writers.

‡ Steppe murrain was introduced into Germany and France between 1795 and 1798 by means of cattle brought from Hungary to supply the Austrian army, then in arms against the French. It was again introduced into Western Europe in the train of the allied armies in 1813; entered France with them in 1814, and continued to devastate the herds of that country until 1816. According to several French authorities quoted by Lévy (*Traité d'Hygiene*), numbers of the diseased animals were killed for the food both of the armies and of the inhabitants.

into Transylvania. From these frontier provinces it has occasionally spread into the interior of the empire, destroying great quantities of cattle, and causing ruinous loss to the proprietors. It is believed to be so contagious that men, dogs, and goats, although themselves uninfluenced by the *virus*, are thought capable of conveying the infection from a diseased to a healthy herd. Although cough is a frequent symptom of steppe murrain there is no pathological similarity between it and pulmonary murrain.

Appearances after death.

The post-mortem peculiarities of steppe murrain are, rapid decomposition, the blood vessels being filled with dark fluid blood, the flesh easily lacerable, and of a brownish red or violet hue. The fourth stomach and small intestines are externally of a dirty blueish red colour. Internally they are dark coloured, especially in the vicinity of the glands, which are reddened, swollen, moveable, and often marked with points or streaks of effused blood. The large intestines are but slightly affected. At a later stage of the disease numerous exudations from half a line to a line in thickness and several lines in diameter, yellowish-brown or reddish in colour, firmly adherent at the centre, but loose and curling at the edges, are found attached to the reddened or violet-coloured mucous membrane of the fourth stomach and small intestines. These exudations, which exist chiefly in the pyloric portion of the stomach, and in the duodenum or first portion of the small intestine, are mostly seated on the solitary glands, but attain their greatest size when on the aggregate glands. On removing these exudations, the membrane beneath appears pitted, of a bright red colour, and punctuated with blood, especially at the central point of attachment. In rarer cases an exudation of false membrane is met with on the mucous membrane of the small intestines. Somewhat corresponding changes are met with on the mucous surface of the respiratory passages. The mucous membrane of the larynx and larger bronchial tubes is found to be reddened in streaks or spots in the earlier stage; in the more advanced stage it is either covered with greenish yellow exudations or coated with a whitish coloured skin-like false membrane. The gall-bladder is usually distended and full of thin yellowish-green bile. Its mucous membrane, of a bright red colour and thickened, presents exudations of a similar character to those found on the pulmonary and intestinal mucous surfaces. The spleen, which is much diseased in *Milzbrand*, another form of contagious murrain to which I shall presently advert, is in this disease generally found to be healthy, although sometimes in a disintegrated blueish-black pultaceous condition. The food in the third stomach is represented as being sometimes met with in friable, compressed discs, lodged between the leaves or duplicatures of the stomach. This peculiarity is mentioned by one of Her Majesty's Vice-Consuls in a telegraphic despatch to the Earl of Clarendon, as belonging to the disease now prevailing on the Russo-Polish frontier of Prussia. In other cases the food in the same stomach is found in the form of moist pultaceous masses.

Publication of an Order in Council prohibiting importation from the Baltic.

As soon as Her Majesty's Government received intelligence that this form of murrain had reached Kowno, Tauroggen, and other places in the vicinity of the Russian frontier, an Order in Council was issued prohibiting the importation of cattle, and of horns, hoofs, raw or wet hides, or skins of cattle into the United Kingdom from any port in the Baltic east of Denmark. It was also ordered that no cattle, and no articles supposed to be capable of conveying infection, as horns, hoofs, raw hides, hay, straw fodder, litter, or manure should be admitted into the United Kingdom, which had been on board any vessel coming from one of the interdicted ports, and that if any such cattle or prohibited articles shall be brought to this country, they shall upon their arrival here be destroyed or otherwise disposed of as the Commissioners of Her Majesty's Customs may direct.* Taken in conjunction with the careful examination of all imported cattle made by the professional inspectors appointed for that purpose, both at London and the out-ports, and with the restrictive measures employed to prevent the spread of the disease into Prussia, this precaution seems to remove all danger of the importation of steppe murrain into the United Kingdom from the north-eastern frontier districts of Prussia, where it at present perhaps exists.

In truth, however, the consideration of measures for the exclusion from the United Kingdom of this avowedly contagious murrain,—for it is asserted to be highly contagious by persons who are the most competent to express an opinion on the subject,—is not a mere temporary question. Steppe murrain is said in Austrian documents of a public character never to be eradicated in countries adjoining to Austria, and the same documents inform us that it often spreads into the interior of that empire. There is at present no prospect of its extinction in provinces some of which are its natural birthplace, and in others of which no measures had until lately been adopted for its eradication. Any further regulations which it may therefore be proposed to adopt, with the intention of excluding steppe murrain from this country, must necessarily be of a permanent character. A good deal of the foreign cattle sold in the Metropolitan live cattle market comes from Prussia. Some of it is said to come from places eastward of Berlin. The facilities afforded by railway communication will, no doubt, eventually be rendered available for the transmission of cattle to the western markets from districts yet more remote. It is asserted that measures are even now in progress to improve the breed of cattle in those remoter districts, with a view to supplying the markets of western Europe. Our real protection hitherto has lain—

Steppe murrain never absent from certain countries.

a. In the energetic measures adopted by intermediate States to secure the exclusion of the murrain from their territories;—

b. In our insular position; and in the length of the transit from those countries into the United Kingdom.

Reasons why steppe murrain has not been introduced here.

* The Danish Government has issued a similar order applicable to the same ports, that the cattle trade between Denmark and England may not be disturbed.

Regulations of continental authorities.

I have already said that measures to prevent the extension of the disease and to effect its extirpation have recently been adopted in the Russo-Polish provinces. Very strict regulations to secure the exclusion of the murrain, or to extinguish it should it be imported over the frontier, have long been employed by the Austrian Government. All infected cattle are immediately killed, and the place where they have been is placed in strict quarantine. In Prussia, all direct traffic over the frontier from infected places is forbidden, the introduction of cattle and other articles likely to convey the contagion being entirely prohibited, and butchers and other persons suspected of having had intercourse with cattle being compelled to undergo quarantine. Similar precautions are adopted when the disease has appeared within the Prussian territories. The infected place is surrounded by military, no intercourse whatever being allowed to take place with it. All oxen, cows, and calves are killed, and buried with quicklime in deep pits. Regulations on this subject dated so long ago as 1803 are still inforce, and a proclamation for the more exact defining of these regulations was issued by the King of Prussia, on the 27th of March1856. In this proclamation it is ordered, that no steppe cattle (Podolian cattle) be admitted into the kingdom, excepting at certain quarantine stations, and after undergoing a quarantine of twenty-one days; that all cattle of the designated breed, after having undergone the prescribed quarantine, be branded on the horns with a particular mark; and that if any cattle of this race, which have not the proper brand, are seen at large in the eastern provinces of Prussia, they be placed entirely apart from all contact with other cattle, and, if they show any suspicious symptoms of disease, be immediately killed. The owners are, of course, indemnified for the loss of their cattle when it is found necessary to destroy them.

Notwithstanding the severity of the regulations enforced by the Prussian and Austrian Governments, through whose territories all cattle coming from the infected districts must pass before it can reach the United Kingdom, our insular position enables us to maintain a much closer surveillance over imported cattle than is possible in continental countries. Moreover, the incubative stage of the disease being said not to exceed seven days, it is unlikely that infected cattle could undergo so long a journey as that from the eastern provinces of Prussia and Austria to the United Kingdom, including the sea passage, without showing some appearance of indisposition on their arrival at the port of debarcation. There is thus just as much, and no more, risk of steppe murrain being now introduced into this country by means of foreign cattle than has already existed for several years.

Our insular position.

The recent alarm in this country unfounded.

The great alarm expressed in this country at the so-called "impending murrain" has been based upon a mistaken supposition, that the disease prevailing in Mecklenburg and Holstein is a disease from which our herds are free, and that it is identical with *Rinderpest* or steppe murrain. On the contrary, as already explained, it is pulmonary murrain, which is as prevalent among

the horned cattle of the United Kingdom as in the herds of Mecklenburg and Holstein. The *Rinderpest* or steppe murrain of German writers has not been prevailing in Mecklenburg and Holstein. It is not more prevalent now in the western provinces of Russia and Poland than it has usually been, and is at present much less prevalent in the territories of Austria and Prussia than it has often been.

3. Dysenteric Murrain.

Dysenteric murrain is referred to in the following extract from a letter, dated February 28th, 1857, addressed to the President of the Board of Trade, and printed by the Commissioners of Customs for the information of the several officers of the Customs, and of the veterinary surgeons employed to examine cattle. There is, however, no reason for believing the writer to be correct in his assertion that the disease has passed by the countries bordering the Danube, "through the Austrian dominions into Germany." Neither is there any present cause for apprehending its extension to countries from which cattle are imported into Great Britain.

Dysenteric murrain at Constantinople.

"In August 1855 I was employed at Constantinople to "purchase bullocks; rumours were then prevalent, that a most "virulent murrain (every epidemic is denominated in the East "by this title) was spreading through the country. The bul- "locks we purchased had been brought some six hundred miles "from the interior of Asiatic Turkey; although poor in con- "dition, they seemed otherwise healthy. But we had not "received them more than three weeks before the epidemic "broke out, both in our camp at Buyuckdere, and in the French "camp, a few miles distant. The whole of our bullocks were "attacked with the disease, and out of upwards of 500, we "lost 116.

"I have no doubt that the same disease is now approaching "our shores; it proceeded from Constantinople in the direction "of Shumla, and thence on the Danube, through the Austrian "dominions into Germany.

"The disease is dysenteric in its character, and approaches "nearer to the Asiatic cholera in the human subject, than any- "thing I have yet seen in Animals, and it is confined to Horned "Stock.

"The parts diseased are the stomachs, liver, and the whole "lining membrane of the bowels.

"It is rapid in its progress, and very fatal in its results. Its "origin is dependent on some atmospheric poison, the nature of "which cannot be determined. It is propagated by contagion, "and chiefly through the excretions, which are of an extremely "offensive character. It spreads with great virulence in cattle "that have been living on bad hay, straw, &c."

The disease here referred to is no doubt correctly described as of dysenteric character, and, as will shortly appear, it really bears the close resemblance to cholera in the human subject attributed to it by the writer of the above quoted letter.

Mr. Radcliffe's account of

Through the courtesy of the Council of the Epidemiological Society, and with the sanction of Mr. Radcliffe, member of the

dysenteric murrain at Sinope.

Royal College of Surgeons, and lately attached to the Ottoman army under the command of H.H. Omar Pasha, I have been permitted to examine an unpublished paper communicated by Mr. Radcliffe to that society upon a murrain which prevailed at Sinope during the summer and autumn of 1855, which was evidently the same as that mentioned in the letter to the President of the Board of Trade.* The symptoms of the disease are thus described by Mr. Radcliffe from his personal observation :—

Symptoms.

" The attack of the disease appeared to be invariably sudden, " and the progress of the symptoms was singularly uniform. " The animal attacked was seized with profuse diarrhœa; ex- " haustion rapidly followed, the animal sinking to the ground; " the breathing became oppressed; a thick glairy mucus trickled " from the eyes and nostrils; and death occurred within *nine* " hours from the commencement of the attack; the duration of " the disease rarely indeed exceeding *six* hours.

" The first symptom of the disease was characteristic. The " animal would suddenly void from the bowels, in a thick stream, " an enormous quantity of fluid matter, which was either of " a pale yellow or of a brownish colour. The evacuations " invariably contained shreds and flakes of lymph and generally " sooner or later more or less blood. The most common appear- " ance of the evacuated matter was that of a yellowish coloured " fluid, in which shreds of lymph were floating."

Appearances after death.

A post-mortem examination of the bodies of four animals that died of the murrain was made by Mr. Radcliffe. The morbid changes were characteristic of rapidly fatal alvine flux. With the exception of the mucous membrane of the paunch or first stomach being, in one case, rather darker than usual, and of the existence of a few patches of congestion on the mucous membrane of the abomasum or true stomach of the third animal examined, the morbid appearances were exclusively confined to the large intestines; the stomachs, the small intestines, and the remainder of the viscera being in a natural condition. The several stomachs contained food in the state characteristic of each, and the intestines were full of a pale yellow or straw-coloured liquid, having the aspect of partially digested food, excessively diluted, in which shreads of lymph were floating. There was an entire absence of fæcal odour. Externally, the intestines had a healthy aspect throughout their entire course, and the changes which presented themselves on the mucous surface of the large intestines, were only discoverable when the bowel was examined on its internal aspect. The mucous membrane of the large intestines presented throughout the appearance of congestion, being studded with florid punctuated patches, formed of minute red spots, thickly grouped together. These appearances seem to have been confined to the true mucous surface, for "in no instance were the " vessels of the sub-mucous tissue congested, so that they could " be traced beneath the patches of congestion."†

* The paper is printed at full length in the Appendix, No. VI.

† For full details of the post-mortem appearances, *see* Appendix, No. VI.

The morbid appearances here described are those of rapidly fatal dysentery, but the symptoms during life more nearly resemble the choleraic form of alvine flux. It was reported that the murrain prevailed in several places contemporaneously with cholera in the human subject, a circumstance which might be only a coincidence, and is not necessarily indicative of any direct relation in the causation of the two diseases. The murrain appears to have been uniformly fatal at Sinope, for Mr. Radcliffe did not hear of any instance in which an animal attacked by it recovered. The disorder prevailed with as much severity among the cattle in the town, and in those collected by the Commissariat in the country, at some distance from Sinope, as among those in the depôt. The murrain was considered as highly contagious by the natives, but the evidence adduced in support of the opinion is said to have been vague and worthless. Mr. Radcliffe, however, believes that it was infectious by means of the effluvia given off from the diseased animals when concentrated by their confinement in crowded sheds; and hence, that the sheds which had been occupied by diseased cattle, being impregnated with the diseased excretions, were capable of producing the complaint in fresh and untainted animals.

The murrain not confined to the animals in the depôt.

In reference to the probability of the disease spreading into districts remote from its original seat, it is worthy of note that after prevailing in Sinope in the spring it attained its acme in June, and then rapidly declined. It did not, however, entirely disappear, for scattered cases continued to occur until November, when a second violent outbreak took place both among the cattle in the town and in the depôt. This outbreak attained its acme about the end of November, declined during December, and ceased altogether in January 1856. No satisfactory evidence could be procured to show whether the disease had been imported or was developed spontaneously, but the town of Sinope during the prevalence of the murrain is reported to have been both filthier than usual, and excessively crowded from a large number of men attached to the Commissariat Depôt and the depôt of the Land Transport Corps being quartered in it. Probably, if we may judge of the disease on the presumption of its analogy with alvine flux in the human subject, the outbreak was partially due to season and partially to local circumstances. To season, because, like cholera and dysentery in man, it disappeared in the winter. To local circumstances, because the crowding of so many cattle into a district, the sanitary state of which was so entirely neglected, must have led to the accumulation of their excreta, the emanations from which probably were the contagious matter, if the disease really spread by contagion.

Spontaneous disappearance of the murrain.

Sanitary state of Sinope and its vicinity.

It has been affirmed on the highest authority that the effluvia arising from the excretions of human dysenteric patients are the means of spreading infection. The disease nevertheless often arises quite independently of any such cause.* As, the large intestines excepted, all the organs of

Probable mode of communication.

* *See* Observations on the Diseases of the Army, by Sir John Pringle, Bart., pp. 86, 263, &c.; and Dr. Copland's Medical Dictionary, vol. i. pp. 698, 699.

the animals which died of dysenteric murrain were found to be healthy, it is, perhaps, not assuming too much to infer that this disease, if it spread by contagion, did so in the same manner as the analogous disease in man; that when the circumstances that had originally caused it were removed, its further continuance could only be maintained by this kind of infection; and that its extension into the herds of other districts could only occur through the same channel. The chief practical importance of this conclusion at present is, that if dysenteric murrain be propagable, and only so by means of the diseased excretions, it is unlikely to be imported into this country. Fatigue and exposure are well known to be powerful causes in accelerating the development of such disorders. Any infected animals, therefore, that might be sent to the port of embarcation, would be likely to fall victims to the disease, if not prior to embarcation, at least previous to their arrival in this country. In regard to this particular kind of murrain, it is therefore, only necessary to continue the regulations at present in force, for the inspection of foreign cattle, and to detain all imported cattle among which there may be any suspicion of this disease, until the Inspector is satisfied they are healthy, a question likely to be determined in a very brief period in this instance. Should the disease show itself in any of the cattle thus detained, the only safe course would be to slaughter the entire importation, and to employ effectual means for destroying the excretions and purifying the vessel and other places in which the cattle may have been from every particle of their alvine evacuations.

Suggestions for exclusion of the murrain from this country.

4. CARBUNCULAR MURRAIN, *or Milzbrand.*

Carbuncular murrain, named in Germany "*Milzbrand*," or black pock, is another specific cattle disease that prevails among the cattle of several continental countries. On account of the great interest that just now attaches to all the contagious diseases of cattle, and also because I shall have occasion to refer to it in that portion of my Report which relates to the effect on human health of consuming the flesh of diseased animals, I may here, perhaps, be allowed to devote a brief space to its consideration. *Milzbrand* is considered by German authors as a typhus disease originating in horned cattle, but communicable to other animals, as horses, sheep, and dogs, and even to man.* By some writers it is believed not to be communicable in the ox,† an opinion that would appear to be disproved by the circumstance of its communicability from the ox to other animals, and it is asserted even secondarily from them to other animals of the same or a different species. It is developed spontaneously under certain atmospherical conditions, and particularly of long-continued high temperature; but the true exciting cause is believed to be of malarious origin. It is said to be developed under circumstances analogous to those which favour the development of plague, with which it seems to have many affinities. It is chiefly propagated by direct contact, but is reputed, under

Communicable to man and animals.

Causes of its spontaneous production.

* Wunderlich, *Pathologie und Therapie.*

† Kausch, quoted by Heusinger in his chronological notice of works on Milzbrand.

very favourable circumstances, to spread likewise through the medium of the atmosphere. The contagion is considered by Heusinger‡, a German writer who has published a voluminous monograph on the subject, to be of the most energetic and indestructible character, and to appertain to all parts of the animal, but especially to the blood, flesh, and hides. Hides are said to have frequently been the means of conveying the disease, a statement at variance with the fact, that whilst hides coming from districts where *Milzbrand* is known to prevail have been freely imported into England, no instances are on record of their having produced it in tanners or other persons who have handled them.

The chief seats of *Milzbrand* are Poland, Silesia, Hungary, Russia, and it is said, Italy. It prevails in summer, and especially in the months of June, July, and August. Dr. Hirsch, of Danzig, a well-known investigator of epidemic diseases, says, in a private communication with which I have been favoured, that it is common in Russian Poland, from whence it is frequently imported into Prussia.* The poison is most rapid in its effects, inasmuch as the disease has often appeared to commence from the moment of infection, a circumstance which precludes the probability of its importation into distant countries by means of living animals. Like plague, *Milzbrand* is characterised by an eruption of gangrenous carbuncles in various parts of the body. Sometimes analogous disease is developed in the lungs or other internal organs. Decomposition takes place soon after death, there being extensive congestion with extravasations of blood in several of the internal organs, and occasional effusion into the serous cavities. The capillary congestion extends even to the bones, which are often so strikingly of a blueish-red colour as to indicate the existence and nature of the disease. The blood is generally found to be pitchy-black and uncoagulated. The glands are commonly enlarged and dark from effused blood. The spleen is usually much enlarged, sometimes enormously so, softened, filled with black blood, and its tissue often broken down. Hence the name "*Milzbrand*," by which this form of murrain is commonly known. In addition to these appearances, Professor Brauell, of Dorpat, in a recently published paper, says, that vibriones are found in the blood, especially in that of the spleen, immediately after death, and considers their existence before or soon after death as being, in the present state of our knowledge, characteristic of *Milzbrand*.† The post-mortem appearances are said to be analogous, whether man or any of the lower animals may have been the subject of the disease.

Nature of disease.

Appearances after death.

II.—*The sale of diseased animals to be used for human food.* I have already mentioned the custom prevalent, among cow-keepers and other owners of cattle, of sending diseased ani-

II. The Sale of Diseased Animals to be used for Human Food.

* *Ueber Milzbrandkrankheiten*, 1850.

† For this, and several other important private communications which have been serviceable to me, I am indebted to Dr. Hermann Weber, Physician to the German Hospital at Dalston, who kindly wrote, at my request, to several German Physicians for information on the subject of my inquiry.

‡ Virchow's *Archiv.* vol. xi,

Common everywhere.

Usually sold at an early period of disease.

Sale at an early period of disease not prevented.

But few unhealthy cattle sent to Metropolitan Live Cattle Market.

Both cattle and meat seized at a later period of disease.

Cattle sent to market suffering from various diseases,

and injuries.

mals to market. This custom is, however, by no means peculiar either to the Metropolis or to the United Kingdom, for it is common also on the Continent to sell animals that are attacked by pulmonary murrain. Animals in good condition are usually sent to market as soon as they manifest any appearance of illness, and before the disease has materially lessened their value. The cow-keepers I saw did not hesitate at once to admit this practice, and there is no doubt that a large number of animals suffering from pulmonary murrain are habitually sold to be slaughtered for human food. Probably a small number only of those sold in the live cattle market are in an advanced stage of disease; animals having even one lung solidified, and the corresponding pleura distended with fluid, being unable to walk to market or bear the fatigue of a long journey from the country. The inspectors of the Metropolitan Live Cattle Market, and of the slaughter-houses and markets in the City of London say, they do not feel justified in seizing animals suffering from an early stage of lung disease, or in preventing the sale of meat because the animal from which it was procured had had that disease, provided the flesh looks healthy. Mr. Fisher, inspector of meat and slaughter-houses for the City of London, who is probably as competent as any one to speak on the subject, says that much of the meat from animals that have had pulmonary disease is of first rate quality. This assertion is quite consistent with the experience of medical men, who do not find the fleshy parts of bodies materially affected by a brief acute illness. Mr. Nice, V.S., inspector of the Live Cattle Market, informed me he had only found it necessary to seize some six or seven horned cattle on account of illness during the last year. I was also told by Mr. Nice, the number of unhealthy cattle sent to market, is much diminished since the removal of the market to its present situation, partly, he believes, because the greater space in the present market lessens the chance of their being overlooked, but in some measure, likewise, on account of its greater remoteness from the cow-sheds. At a later period of the disease, when emaciation has taken place, and especially if anasarca (general dropsy) has supervened as a consequence of the pulmonary affection, the animals are seized if taken to market, or, if privately slaughtered, the meat is seized when exposed for sale. All meat taken in the City Markets as unfit for human consumption is sent to the melters, and there destroyed. Although by far the largest number of diseased oxen that are sent to the Metropolitan Cattle Market are the subjects of pulmonary murrain, there can be no doubt but there are likewise some which have other diseases. I have heard of abscesses being found in the lungs of slaughtered cattle, and occasionally, but less frequently, in other parts of the carcase. Cattle brought by rail, too, are often injured on the journey. Those that are weak or tired lying down in the vans are liable to be trampled on or kicked by their companions. Such injuries are no doubt the cause of the extravasations of blood said to be sometimes observed in the muscular parts of animals slaughtered for food.

Metropolitan Cattle Market.

During the course of my investigations I several times visited the Metropolitan Cattle Market early in the morning; and, sometimes alone, on other occasions accompanied by Mr. Nice, walked round to look at the cattle. On these occasions I did not see in all more than two or three animals that looked otherwise than well, and these were cows from the London cow-sheds, suffering, I believe, from the earliest stage of pulmonary murrain. On Friday, March 27th, one of the occasions referred to, several very lean, emaciated, poor-looking cattle, which at once attracted my notice as very unlikely to be good meat, were exposed for sale. On inquiry I learnt that these animals were bought by speculators for the purpose of fattening on the Essex marshes, and that very probably the greater number of them would be brought to market again in a few months in greatly improved condition. Had I not examined into the matter, I should have left the market with an impression that, on that occasion at least, a large quantity of poor cattle was sold to be slaughtered for human food.

Lean cattle sold for fattening.

Diseased foreign cattle rarely met with.

Little, if any, of the diseased cattle sold in the London market comes from abroad. Mr. Nice has not had occasion to seize a single foreign ox during the past year. This, no doubt, arises from the strict supervision maintained over imported cattle by the professional inspectors of the Board of Customs. A return of the animals seized by the inspectors of the port of London, furnished to the General Board of Health for the purpose of this inquiry, shows that seven horned cattle were seized and condemned as unfit for human consumption between the 1st of January and 17th March 1857.* This stringency has, no doubt, an indirect beneficial influence by checking any disposition, should it exist on the part of the foreign exporter, to send unhealthy cattle from abroad.

Beneficial effect of inspecting foreign cattle.

The diseased cattle sold in the Metropolitan Live Cattle Market forms but a very small portion of the diseased cattle slaughtered in London for human food. Some is no doubt sent direct to the slaughter-houses and there disposed of, but a much larger quantity is purchased by persons who go from one cattle shed to another for the purpose of buying sick cattle. I am informed these persons buy it even when so ill as to require a cart for its conveyance from the place, and that it is usually removed at night. The animals thus obtained are taken to some of the public† slaughter-houses and killed, their flesh being disposed of to dealers who exclusively traffic in this inferior article.

Private sale of diseased cattle.

No slaughter-houses for the exclusive killing of diseased cattle.

I have been unable to obtain any satisfactory proof of the existence of any slaughter-houses especially devoted to the slaughter of diseased animals, and should think their existence doubtful. No doubt there are slaughter-houses in which a large

* For this return and also for the instructions drawn up for the guidance of the inspectors,—See Appendix, Numbers IX. and X.

† A public slaughter-house is a place where cattle not belonging to the proprietor are killed at a certain charge. They are in no sense of the term public property, or more under the control of the public authorities than private slaughter-houses.

quantity of diseased cattle is killed, but the general tendency of the evidence, I received, was to show that such animals are more or less indiscriminately slaughtered in all public slaughter-houses. It is, however, most difficult to obtain precise information on this point, for the system of inspection is much less perfect beyond the limits of the city, where probably the worst animals are killed.

Slaughter of diseased cattle for food in provincial towns.

Let it not, however, be supposed, that the slaughter of diseased animals for human consumption is confined either to the city or the metropolis. The custom is more or less prevalent in all large towns. Mr. John Summerscales, town clerk of Oldham, in evidence given by him before a Committee of the House of Lords in 1850*, mentions the existence of the practice in Oldham, and he believes in Manchester, Bolton, Ashton, and Bury; and Mr. Rawlinson, in his report to the General Board of Health on the sanitary state of Newton Heath, gives an account of the same system as pursued by the *slink-butchers* of that place. The details of the practice in Newton Heath are furnished in a letter from Mr. Joseph Taylor, surgeon, addressed to Mr. Rawlinson, as Superintending Inspector of the General Board of Health.† These butchers are there described as persons who purchase and kill diseased cows and other animals, and also buy the carcases of such animals as may have died, which they dress up for market, and dispose of wholesale, chiefly for the markets of Manchester and Salford. The meat is chiefly sold to the proprietors of stew and pie shops, but is also partially retailed to the poorer classes, at about $1\frac{1}{2}d.$ per pound. In a district of Newton Heath, called Gagg's Fields, there are many slaughter-houses of this description, at each of which from five to twenty cows per week, besides other animals, are dressed, for the food of man.

Diseased meat sent from the country for sale in London.

In addition to the diseased cattle slaughtered in the metropolitan slaughter-houses, a great deal of diseased meat is brought ready dressed for sale to London from the country. The sale of this is not exclusively confined to second-rate shops, or localities inhabited by the poor. A first-class west-end butcher, whose business lies exclusively among the wealthier classes, informs me that a good deal of what he calls *hazardous meat* is sold by respectable tradesmen. Dr. Challice, Medical Officer of Health for Bermondsey, also told me he had seized diseased meat in shops by no means of the lowest class. Other persons assert that the sale of inferior and diseased meat is on the increase from the high price of provisions: cheapness being (as was also said by Mr. Summerscales, in the evidence already referred to) so great an inducement to the poorer classes, that they risk the quality of the meat, and buy it where it can be procured cheapest. The facili-

Sale of hazardous meat not limited to second-rate shops or localities.

* Report from the Select Committee of the House of Lords, appointed to consider the operation of the Acts for the Prevention of Infectious Diseases in Cattle, &c., pp. 21, 22.

† Report to the General Board of Health on a preliminary inquiry into the sewerage, drainage, and supply of water, and the sanitary condition of the inhabitants of Newton Heath, by R. Rawlinson, Esq., Superintending Inspector. London, 1852. p. 52.

ties of transmission afforded by railways and steam-boats have tended to increase the amount of ready-dressed meat sent from the country to the metropolis. I have no means of estimating the present amount of dead meat sent to the London markets; but, in the report of the Commissioners appointed to make inquiries relating to Smithfield Market, it is said to have averaged at least 800 tons a week in 1850, and the quantity is understood still to be increasing. It is said in the same report that the number of salesmen in Newgate Market had increased, in the space of 40 years, from 13 to 200, and that the sale of dead meat had more than doubled within ten years, the amount of country killed meat having quadrupled in the like period. As the only restriction on the transmission of diseased meat to London is the danger of its seizure on its arrival in town, it is believed that a great deal of such meat is slaughtered in the country, and sent ready dressed for sale in the metropolis. Mr. John Harper, who had been for several years connected with the management of the Islington Market, asserted in evidence given before the Smithfield Market Commission in 1850, that the London market was at that time very extensively supplied with diseased meat from the country. "There are, says Mr. Harper, "three insurance offices in London, in which gra- "ziers can insure their beasts from disease; it was the practice of "one of these offices to send the insured animals dying from disease "to their own slaughter-houses, situate 160 miles from London, to "be dressed and sent to the London markets." "The diseased animals "when dead become the property of the insurance company, the "party insuring receiving two-thirds of the value of the animal, "and one-third of the salvage; or, in other words, one-third of the "amount the beast is sold for when dead."* He added, in reply to a subsequent question, that the meat was no longer consigned to salesmen in Newgate Market, but sold more privately "in the "slaughter-houses and private places out of the city."

Sale of country-killed meat increasing.

Mr. John Harper on sale of diseased meat.

Excepting in cases of long standing chronic disease giving rise to paleness of the flesh, or to general dropsy, it is often impossible to distinguish the meat of a diseased from that of a healthy animal when cut up for sale. Hence the absence of efficient inspection in many of the places from which dead meat is supplied to the metropolis affords a ready means for the disposal of unhealthy animals. It was indeed affirmed both by Mr. Fisher, inspector of meat and slaughter-houses for the City of London, and also by Mr. Pocklington, inspector of Newgate Market, that the amount of diseased meat sold in that market has of late greatly diminished. Although this may be true of the city markets, in which there is a regular system of inspection, I have reason to believe the quantity of diseased meat sold in the extra-mural portion of the metropolis is on the increase. I was likewise informed that a good deal of very inferior meat is disposed of in the vicinity of

Diseased meat sometimes difficult to distinguish.

* Report of the Commissioners appointed to make inquiries relating to Smithfield Market and the Markets in the City of London for the sale of meat. Minutes of Evidence, p. 70.

Newgate Market, particularly in Warwick Lane, and that much diseased meat is there sold early in the morning and also late on the Saturday evening. It is the habit, I am told, of many respectable tradesmen, both at Newgate and Whitechapel Markets, to let their rails on Saturday, when their own business is over for the day, to an inferior class of dealers, who sell diseased or poor meat to the humbler classes. It might be supposed that so inferior an article would not obtain purchasers, but for the reason of cheapness already assigned, there is no difficulty in disposing of any quantity of such meat. Mr. Harper, to whose evidence before the Smithfield Market Commissioners I have already referred, said he was certain "that if 100 carcases of cows were lying "dead in the neighbourhood of London, he could get them all "sold within twenty-four hours," no matter what the complaint of which they had died.

Inferior meat sold at unusual hours.

Ready sale for diseased and inferior meat.

A much greater quantity of diseased and inferior meat is sold in a manufactured form than is disposed of as joints for cooking. Much meat that is diseased and otherwise unsaleable is sold for sausage meat. Dr. Challice, medical officer of health for Bermondsey, informed me he has seized diseased meat in the process of manufacture into sausages; and Mr. Fisher says, that such of the diseased cows as are too bad for sale as meat are chopped up to make German sausages and saveloys. Mr. Rowell, inspector of nuisances for Paddington, expressed a similar belief. Even putrid or at least tainted meat is said to be made available for the same purpose, pyroligneous acid being employed to remove the smell. Mr. Harper, in the evidence already referred to, says, that a great deal of diseased and bad meat is purchased by the soup-shop proprietors, sausage makers, the alamode-beef and meat pie shops, and the manufacturers of polonies. He referred to one soup shop as "doing 500*l.* a week "in diseased meat;" adding, "this firm has a large foreign trade." That the sausages commonly sold for the consumption of the poorer classes are made of inferior meat is evident from their price. Beef sausages, I am told, are commonly retailed at the rate of 4½*d.* to 5*d.* per pound, which is below cost price if they were composed of sound meat.

Sale of diseased meat for sausages, soup, and pies.

It is but due to the authorities of the City of London to repeat, that great efforts are there made to check the sale of diseased and unwholesome meat. These efforts are no doubt partly frustrated from the difficulty of distinguishing diseased meat when cut into joints. Much diseased meat is also sold because of the absence of a definite understanding as to what ought to be condemned. It is, for example, by no means understood that animals suffering from pulmonary murrain are on that account unfit for food. They are therefore permitted to be sold in the live cattle market, unless the disease be in an advanced stage, and the sale of their flesh in the shops is not interfered with, so long as it looks fair and good. A return of the amount of articles seized by inspectors of slaughter-houses, in the City of London, for the two last years, with which I have been favoured

Efforts of the City authorities to repress the sale of unwholesome meat.

The intention of the law undefined.

by Mr. Daw, the principal clerk to the City Commissioners of Sewers, is printed in the Appendix.* From an examination of this document it is apparent that the inspection must tend very greatly to diminish the sale of unwholesome meat within the jurisdiction of the Commissioners. It is also not difficult to infer what must be the extent of the evil, where a similar supervision is not exercised.

Varieties of unwholesome meat seized in City of London.

The returns of meat seized by the City inspectors as unfit for food include the three following classes, which are not distinguished from each other in the returns; viz.,

1, Diseased meat,
2, Putrid meat, and
3, Physic meat.

1. *Diseased meat.*

Under the first head, as already mentioned, only such meat as is derived from animals in an advanced stage of disease is included. The flesh of animals dying under accidental violence, or from other obviously local causes, is not seized. It is considered as an inferior kind of meat, looks less fair than such as has been properly slaughtered, and is liable to putrefy sooner; but not being believed to be unwholesome, is permitted to be sold.

2. *Putrid meat.*

Putrid or even tainted meat is invariably seized, and, I am informed by Mr. Fisher, constitutes by far the largest proportion of that comprised in the return.

3. *Physic meat.*

Physic meat is also invariably seized. It is meat derived from animals that have taken medicine in sufficient quantity to impregnate the flesh with its odour. Some judgment is often required to decide whether the smell is from medicine or food, certain kinds of food, such as turnips, tainting the flesh with their special smell.

Alleged sale of carrion.

Whilst my inquiry was in progress, I was informed that the carcases of oxen that die on their passage from Hamburg and other foreign ports, thrown into the river at a particular point, are picked up by a certain class of butchers, dressed, and sent to the dead meat market. I have been unable to verify the precise fact referred to by my informant, but have ascertained that three persons were charged at the Mansion House on October 11th, 1854, with sending the carcase of a putrid ox which had been picked up in the river, off Greenhithe, to Newgate Market. The ox had been thrown overboard from the "Tiger" steam vessel, with cattle from Tonning. The prisoners were committed for trial at the Central Criminal Court, and tried on October 27th, but acquitted in consequence of asserting that they had instructed the salesman, to whom the meat was consigned, not to offer it for sale if found unfit for human food. Having received a severe reprimand from the recorder, they were liberated. As the flesh of animals that die is not forbidden to be sold, there is evidently no check to the sale of such carrion as is here referred to, provided the flesh do not come under one of the three heads of diseased meat, putrid meat, or physic meat.

* Appendix, No. VIII.

III. The Effects on Human Health of consuming the Flesh of diseased Animals.

Absence of satisfactory data.

III. *The effects on human health of consuming the flesh of diseased animals.* I have been unable to ascertain that eating the flesh of animals that have suffered from pulmonary murrain produces any injurious consequences on human health. As, however, animals suffering from other diseases are also sent to the shambles, it is necessary to refer more generally to the subject of diseased meat. Much difference of opinion exists among medical men as to the effects of eating the flesh of diseased animals. Some deny the production of any injurious result from its consumption ; others assert that the use of diseased meat is unwholesome, and frequently attended with most injurious consequences. A third party say, that no bad consequences follow the use of such food, if thoroughly cooked. Perhaps this discrepancy of opinion is partly caused by different forms of disease being referred to, for although the flesh of animals that have suffered from disease may often be innocent and even wholesome, it is nevertheless possible that meat from animals that have had certain diseases may be injurious. Moreover, the flesh of animals that have suffered from particular diseases undergoes more rapid decomposition than that of healthy cattle. This was so evidently the case with that of animals which had suffered from one of the forms of murrain prevalent in this country about the middle of the last century, that Dr. Brocklesby* advises meat to be kept three or four days without being salted, as a test of its wholesomeness. "If it "remains so long in temperate weather without tainting, there "is good reason to consider it wholesome." This affords, however, no real test of the wholesomeness of meat, for the flesh of oxen that have been over-driven is also apt to undergo more rapid decomposition. Such meat is perhaps less profitable to the butcher, from the risk of loss by its spoiling prior to sale, but, if eaten early enough, it is probably not the less wholesome, the tenderness of incipient putrefaction being favourable to digestion.

That the sale of meat from diseased cattle is often a fraud upon the purchaser, must be admitted. That the flesh of animals that have suffered from chronic disease is less nutritious than that of healthy animals, is also very probable. Perhaps these two propositions comprise all that can at present be said with certainty on the subject, so far as England is concerned. It is said, that diseases prevail among horned cattle, both in America and on the Continent, which render the use of their flesh dangerous to man. Happily the diseases referred to are either altogether unknown, or extremely uncommon, in the United Kingdom. The sale of, what has been already spoken of as, hazardous meat by respectable butchers must, strictly speaking, be considered as a fraud ; because, in such cases, the meat is probably sold as a first-class

Use of diseased meat said to be injurious abroad.

Sale of diseased meat often fraudulent.

* An essay concerning the mortality now prevailing among the horned cattle, &c. by Richard Brocklesby, M.D., p. 28.

article, and fetches a first-class price. The sale of inferior and diseased meat in low neighbourhoods, and at a lower price than good meat is known to fetch, bears a somewhat different aspect, as the low price charged for the article at once bespeaks its inferior quality. Upon the whole, perhaps, whilst our knowledge of this subject remains so limited and indefinite, it is not requisite to prevent the sale of meat from animals in an early stage of such diseases as are usually met with among the horned cattle of England, the sale of the diseased organs themselves being of course excepted. On the other hand, when anasarca has occurred, or the aspect of the flesh has become materially changed by disease, no part of the animal should be permitted for sale, for it may fairly be assumed that, if such meat be not actually injurious to health, it is yet ill adapted for supporting healthy nutrition. This is the course said to be pursued by the inspectors of meat for the city of London, and it appears consistent with justice both to the public and the salesmen. It is much to be desired that a similar system of inspection should be extended to other districts. Probably such a system of slaughter-house visitation as provided for the general inspection of all animals, either before being killed, or at least prior to the removal of the viscera, would be the most effectual mode of checking the sale of meat derived from animals in an advanced stage of disease. Whilst upon this subject, it will be well to quote such opinions and facts relating to this branch of my inquiry as will serve to show the real present position of the question.

Desirableness of a general inspection of cattle and meat.

In a report on unwholesome meat, published by the Association of Metropolitan Officers of Health, it is said, "there can be "no doubt but that the use of diseased meat may be a specific "cause of illness." This remark is strictly true, in the sense in which it appears to have been used, as applied to the production of entozoa in the human subject, from eating the flesh of animals which contain the germs of these parasites. It is also said in the same report, that "instances have come under the notice of "Dr. Gibbon, Dr. Challice, and other members of the Committee, "of symptoms of poisoning arising from the use of unsound meat "partially cooked." It is further reported by the same Committee that Dr. Druitt has seen several instances of illness from eating the meat of the overfed cattle that are commonly killed at Christmas. I found, however, on inquiry of these gentlemen, that they were unable to furnish me with any specific facts on the subject. Dr. Challice, the active Medical Officer of Health for Bermondsey, has an impression that diseased meat often causes sickness and diarrhœa, but could furnish no absolute data on the subject; and the case referred to in the Report, as having fallen under Dr. Gibbon's notice, was that of a family poisoned by putrid sausage meat. Dr. Druitt, in a note which he obligingly sent me, in reply to my inquiries, says he "never saw any case of illness arise "from eating the meat of diseased animals." "At least, none that "he could identify." The cases that fell under his observation, in which the meat derived from over-fed cattle had caused illness,

Report of Metropolitan Association of Officers of Health on unwholesome meat.

Dr. Challice.

Dr. Gibbon.

Dr. Druitt.

occurred "a few years since." Dr. Druitt says he was then frequently consulted for cases in which, after partaking of such meat, the patients suffered from vomiting and diarrhœa. The sufferers usually complained that the peculiar strong taste of the fat clung to them. Dr. Druitt cites one instance, in which such illness was caused by eating the kidney of a prize Christmas sheep. It would be unsafe to draw any conclusions from such imperfect data; but if the indisposition was not in these cases chiefly due to repletion, perhaps the explanation of such occurrences might be found in the diet of the animals, and in the retention by the flesh of some strong flavour derived from that source. Taken in conjunction with the fact mentioned in the preceding section of this Report, that the flesh of animals becomes imbued with the smell and taste of medicine, or of particular kinds of diet, the information of Dr. Druitt is suggestive of the inquiry whether the mode of feeding cattle may not sensibly influence the wholesomeness of meat.

Mode of feeding may affect the quality of meat.

Opinion of Dr. Heusinger on the use of diseased meat.

In a letter to Dr. Hermann Weber, in reply to inquiries suggested by myself for my present investigation, Dr. Heusinger, of Marburg, says that he considers the flesh of all diseased animals to be unwholesome, especially when eaten underdone. Dr. Heusinger is a great authority on such subjects, and the author of a most elaborate and excellent work on Milzbrand.

Of M. Payen.

M. Payen,* a recent French writer on food, says it is proved by experience that the flesh of diseased animals, even when they have suffered from contagious complaints, may be consumed by man or animals without producing any toxical or deleterious effect.

Of Baron Liebig.

Baron Liebig says that the poisonous matter of the contagious fever of cattle (*typhus contagiosus ruminantium*), which is but another name for steppe murrain or *Rinderpest*, loses its power of contagion in the stomach.†

Use of diseased meat at Paris in 1814.

Large numbers of oxen and cows, suffering from a typhous epidemic, followed the allied armies to Paris in 1814. The entire population of Paris and the suburbs, including the troops that surrounded and occupied the capital, fed upon the meat of the diseased animals for two months, without any increased amount of sickness or the production of any epidemic disease.‡ None even of the animals that died were lost.

Use of diseased meat at Strasburg.

M. Coze, Sen., who made extensive and precise observations upon the effect of meat derived from diseased cattle, relates that a thousand large oxen suffering from typhus were consumed by the allied and French armies, and by the inhabitants near Strasburg, in 1815.§ Many of the animals were slaughtered when actually at the point of death, and their flesh was consumed for food. Yet this food produced no disease, and did not even disorder the

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* *Des substances alimentaires, et des moyens de les améliorer, de les conserver, et d'en reconnaître les altérations*, par A. Payen, Membre de l'Institut, etc.

† Chemistry in its applications to Agriculture and Physiology. 3rd edition, p. 375.

‡ *Traité d'Hygiéne*, par Michel Lévy. Vol. ii. p. 672.

§ *Loc. cit.* p. 673; also *Mémoires de la Société Royale d'Agriculture de Paris*, vol. xx. 1817.

digestive organs of those who used it. Huzard, J. P. Frank, Parent-Duchatelet, and other writers, have expressed similar opinions. M. Huzard, perhaps correctly, designates the flesh of diseased animals as being meat of inferior quality, and not dangerous to health when cooked. He makes, however, an exception in the case of animals that have had carbuncular murrain, to which I shall presently advert.* A class called Chummars, natives of Hindostan, live upon dead meat, and are, notwithstanding, a remarkably healthy race. They say they will eat any fish, flesh, or fowl, that dies of whatever nature, only let them cook it in their own way. There is among them no particular sickness attributable to their eating tainted or diseased meat; on the contrary, they are reported to be a very healthy race of people, and when ill to suffer chiefly from the effects of drinking to excess, and from the intermittent fevers and other complaints of the climate.† M. Soumille, of Avignon, in a recently published prize essay, says that the consumption of diseased meat may be permitted without danger to health, where there is neither emaciation nor paleness of the flesh. This entire subject has not received the careful investigation in this country that it deserves, for it is surely desirable the question should be so far settled as to lead to the adoption of some uniform police regulations in regard to the sale of diseased meat.

Meat from diseased animals is of inferior quality.

Use of diseased meat in India.

Opinion of M. Soumille.

Dr. Taylor, of Guy's Hospital, in his work on poisons, says that as a general principle "we shall be justified in admitting "that the flesh, as in the *pestis bovina*, must, more or less, "partake of the diseased state of the animal, and thus be "unfitted to serve for human food." *Pestis bovina* is, however, unknown in this country, and the name is often applied indifferently to *Milzbrand* or carbuncular murrain, and to *Rinderpest* or steppe murrain.

Opinion of Dr. Taylor.

Milzbrand, as I have already said, differs in this respect from both steppe murrain and pulmonary murrain, that it is communicable to man and also to many of the lower animals during life. There is also no doubt that handling the carcase after death is very liable indeed to be the means of infection, and that tanners, butchers, and others, have in consequence very often suffered from this very fatal disease.‡ Most contradictory evidence as to the danger of eating the flesh is given by authorities apparently of equal weight. J. H. Kopp says many persons have eaten the flesh without injury, whilst others have suffered from the disease in consequence of doing so.

Supposed communication of carbuncular murrain by the use of diseased meat.

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* *Annales d'Hygiéne*, vol. x., p. 80, &c.

† Report on Small Pox, in Calcutta, and Vaccination in Bengal, by Duncan Stewart, M.D., Surgeon, E.I. Co.'s Service, Superintendent General of Vaccination, &c. Calcutta, 1844. pp. 105–110.

‡ Many examples of the kind are related in Heusinger. *Uber Milzbrandkrankheiten*, 1850.

See also Canstatt's *Bericht*, 1852, vol. vi. p. 67; Rust's Magazine, vol. xxv. p. 105; Jos. Montfils *d'une maladie fréquente, connue en Bourgoyne sous le nom de Puce Maligne. Journal de Médecine*, 1776; and, a recent paper by Professor Brauell, of Dorpat, in *Virchow's Archiv.* Vol. xi.

Montfils*, Thomassin†, Hoffner‡, Garganico§, Rust‖, and others, relate cases in which carbuncular disease, and often death, were produced by eating the flesh of animals that had suffered from this complaint. Some of the examples given appear very clear, but others are more questionable. To the latter class belongs the account given in Rust's magazine of the illness of fifty persons in Westphalia who had eaten the flesh of a cow which had died of *Milzbrand*. They all suffered from symptoms of gastric irritation, but none of them from carbuncular disease, and all eventually recovered. The recovery of the whole is opposed to the usual history of genuine *Milzbrand* produced in the human subject by contagion from animals, a large proportion of such cases proving rapidly fatal. Thomassin relates the occurrence of twenty-eight cases in the human subject in the district of Oppeln in 1834, eleven of whom died. Of thirty persons affected by the same disease in the neighbourhood of Landsberg in 1807, fifteen died. Heusinger estimates the annual deaths in Germany from *Milzbrand*, whether produced by eating the flesh or by immediate contact with the disease, at from two to three hundred, and says it is still more fatal in Italy, Hungary, and Russia. Thousands of men, he says, annually die of this disease in Europe.

Fatality of carbuncular murrain in man.

It is difficult to reconcile evidence of so inconsistent a character, unless by supposing either that the different reporters refer to different stages of the disease, or that the different result depends upon the more or less perfect cooking of the meat. Kottmann, Gesner, Osiander, and others, take the latter view of of the case, and consider the meat of animals that had *Milzbrand* as harmless when cooked. Carbuncular murrain is happily unknown in this country, but, boils and analogous affections in the human subject having increased very much during the last six or seven years, it is not impossible that sooner or later the same cause, whatever it be, which has produced them in man, may also affect the ox. Should this happen, it would become a very very important question whether the flesh of animals that had suffered severely from such an affection ought to be disposed of for food. A case quoted from the "Annali Universali di Medicina" is related by Dr. Taylor¶, in which 60 persons, who partook of the meat from a heifer which had two carbuncles on the buttock when killed, were seized with severe symptoms of gastric irritation. With one exception, all the patients recovered, under the use of simple remedies. As the flesh of animals that have suffered from such affections undergoes much more rapid decomposition than is the case in healthy animals, possibly the meat in question was in a state of early putrefaction. Coupled, neverthe-

Poisonous effect of eating the flesh of animals that have suffered from carbuncle.

* Loc. cit.
† *Diss. sur le Charbon Maligne, &c.* Basle. 1782.
‡ Aschaffenburg. 1783.
§ Rust's Magazine, vol. xliv.
‖ Magazine, vol. xxiv. p. 490.
¶ Guy's Hospital Reports. Second series. Vol. i. p. 16. Hufeland's Journal, 1815.

less, with the injurious results that are said to have so often followed eating the flesh of animals which have suffered from *Milzbrand*, this case suggests the necessity of care in regard to that of animals that have had carbuncle, until the danger or the harmlessness of eating such meat shall have been more thoroughly investigated.

Poisonous meat in America.

The cattle of a certain district in America are subject to a disease which renders their flesh poisonous to man. The subject attracted the attention of Hennipin in the last century, and was investigated afresh conjointly by Drs. Post, Hosack, and Chilton, of New York, in consequence of the occurrence of a number of cases of virulent sickness in that city in December 1842. It was found on investigation that all the sufferers had partaken of smoke-dried beef purchased from the same grocer. It does not conclusively appear whether the illness in the particular instances, which led to the investigation, might not have arisen from the meat having undergone a modified form of putrefaction; but an extension of the inquiry proved that a disease peculiar to animals exists in the districts of Indiana, Illinois, and the western states north of the Mississippi, "which has long been known to exert a "deleterious influence on all individuals of the human race who "have consumed either the flesh, the milk, or the butter of these "animals." "In the early settlement of the country the existence "of this scourge in any given locality was frequently sufficient "to break up many a community that was in other respects "most advantageously situated. The condition on which many "large settlements *exist at the present day* is, entire abstinence "from the flesh of their cattle, as well as the milk, butter, and "cheese made in their own district of country." It does not appear necessary for the animal to have the disease in order that the flesh or other product should produce the poisonous effects on man, for the milk and flesh often acquire poisonous properties whilst the animal itself enjoys good health. Perhaps, as has been suggested, the use of a particular kind of herbage, upon which, within certain limits and under particular conditions, the animal is able to feed with impunity, may render its flesh and other products poisonous to mankind.*

General considerations on unwholesome meat.

The great importance of this subject and the uncertainty with which it is beset render it perhaps not improper for me to enter briefly into the general question of unwholesome meat, and the mode in which it acts injuriously on human health. The consideration of meat rendered unwholesome by putrefactive change, or by the diet of the animals from which it is derived, is so nearly allied to that of diseased meat that it is difficult to treat satisfactorily of the one without also referring to the others. I propose, therefore, to consider them together

MODE OF ACTION OF UNWHOLESOME MEAT.

Admitting that in certain exceptional cases the disease existing in an animal at the time of its death is capable of communication

* I have been unable to procure the original Report. The above account is taken from Dr. Stewart's "Report on Small Pox in Calcutta," &c. 1844, p. 94—104, and from the "Edinburgh Medical and Surgical Journal." July 1844.

to persons who consume its flesh, unwholesome meat may evidently act very seriously on the human constitution in one of the following ways, namely :—

1. As containing parasites;
2. As containing matter directly poisonous ; whether,
   a, resulting from some peculiar food of the animals during life, or
   b, formed by decomposition after death.
3. As conveying the infection of specific brutal diseases.
4. As containing certain putrefactive ferments.

Beneficial effects of cooking.

With the exception of meat rendered poisonous by some peculiar food of the animal during life, and, perhaps, also of that which has been made poisonous by the products of decomposition after death, the effects on health must, in all these cases, be much influenced by the process of cooking. The temperature to which meat is exposed when thoroughly cooked will probably always destroy parasites, disinfect it of contagious properties, and arrest the progress of putrefactive fermentation in albuminous matters, which might otherwise be the means of setting up an analogous action in the living body.

1. Meat containing parasites.

1. *As containing parasites.* Although the introduction of parasites into the human organism by the consumption of the flesh of infected animals is a very important question, it has not formed a part of my present investigation, and may, therefore, be passed by with the brief reference already assigned to it.

2. Meat containing matter directly poisonous:— a. resulting from the food of the animals during life ;

2. *As containing matter directly poisonous.*

a. The mode of action of meat rendered poisonous from the use by the animal during life of food harmless to the beast, but deleterious to man, must depend on the special character of the poison. It may be exerted locally on the stomach, or it may be absorbed, and thus act more indirectly upon some remote organ. The well-known fact that the use of particular kinds of food and medicine influences the odour and taste of meat, and the assertion that ruminating animals can eat plants with impunity that are injurious to the human being, suggest the possibility of this mode of poisoning. If it be true, as is said, that the milk, butter, and flesh of animals inhabiting certain parts of America are poisonous, whilst the animals from which they are derived continue to enjoy good health, this supposition seems to afford the only rational explanation of the circumstance.

b. formed by decomposition after death.

b. The diarrhœa and vomiting caused by the eating of tainted or putrified meat in persons unaccustomed to its use, affords an illustration of the mode in which meat, rendered poisonous by decomposition, acts injuriously on human health. Probably the poisoning of the forty-three persons who had eaten smoked beef purchased at a particular shop in New York, in all of whom the symptoms were of a choleraic character, is referable to this class. It would be easy to cite numerous illustrations of a similar

description ; but the following, related by Dr. Christison, is important, and will suffice for my present purpose.* "In the autumn of 1826, four adults and ten children "ate at dinner a stew made with meat taken from a dead "calf, which was found by one of them on the sea-shore, "and of which no history could be procured. For three "hours no ill effect followed." But they were then all seized with illness. "One person died comatose in the "course of six hours ; the rest eventually got well." The meat, they said, looked well enough at the time it was used, yet the remains of the dish, which formed the noxious meal, had a black colour and nauseous smell ; and some of the flesh, which had not been cooked, had a white glistening appearance, and was so far decayed that its odour excited vomiting and fainting. The only conjecture which the facts will warrant, as to the cause of the poisonous quality of the meat, is that, in consequence of having lain long in the water, the flesh had begun to undergo the adipocerous putrefaction, and that in the course of the changes thus induced the meat became impregnated with a poisonous principle.

Poisoning by decomposin veal.

3. *As conveying the infection of specific brutal diseases.* Unless we admit the complaint caused by using the flesh of the poisonous oxen of North America to arise from contagion, carbuncular murrain is at present the only disease reported, on good authority, to be propagated from brutes to man by means of the flesh when used for food. There is no doubt, from the references to continental authorities given in the preceding section, that the flesh of animals which have suffered from carbuncular murrain at the time of death is capable of communicating the infection when eaten. The only question is whether it does so when cooked. Probably a good deal depends upon the heat to which it may be exposed in the process of cooking, for whilst it is scarcely probable that a contagious poison should resist the action of an elevated temperature, it is quite possible that half-raw, underdone meat might retain its infectious properties. This is more likely to occur with roast than boiled meat, the albumen of the central portions of a roast joint very often remaining uncoagulated after the cooking is considered complete.

Meat conveying the infection of specific brutal diseases.

4. *As containing certain putrefactive ferments.* Putrid infection is a more frequent consequence of meat in an early stage of putrefaction than of that which is undergoing rapid and more perfect change. It is also very often caused by a peculiar form of the putrefactive process which arises in meat that has been imperfectly cured.

4. Meat containing certain putrefactive ferments.

At a public festival at Zurich, in the year 1839, upwards of 600 people partook of veal which was afterwards found to have

Poisoning by putrid meat at Zurich.

* Christison on Poisons. Third Edition. p. 594. London Medical Repository. Third series, iii. 372.

been in an early stage of putrefaction. At variable intervals afterwards, nearly all those who had attended on the occasion were taken ill with symptoms akin to those of typhus fever. Many of the cases proved fatal.* The best illustration of putrid infection by means of imperfectly cured meat is afforded by the history of the well-known poisonous sausages of Germany. The symptoms of poisoning seldom begin until twenty-four or even forty-eight hours after eating the poison. In this respect the sausage poison resembles the true zymotic diseases, which have invariably an incubative stage prior to the commencement of symptoms, during which it may be presumed the exciter is communicating its peculiar condition to the fluids of the patient. After very remarkable symptoms the patient either dies between the third and eighth days, or recovers after a very tedious and protracted convalescence.† All the accounts concur in stating that the bodies of persons who have died in consequence of this poison resist putrefaction. Baron Liebig says, that there is, during life, a gradual wasting of the muscular fibre, and of all the similarly composed constituents of the body, accompanied by emaciation. Liebig attributes these effects to the inability of the stomach to arrest the decomposition in the sausages, which, entering the blood whilst still in a state of progressive change, impart their peculiar action to the constituents of that fluid. The sausages, during the decomposition of which this formidable poison is generated, are said to undergo a peculiar form of putrefaction when improperly cured. The putrefaction begin at the centre, and is not accompanied by any appreciable evolution of gas. The sausage becomes paler in colour, more soft and greasy, and is found to possess an acid reaction. Such sausages are usually eaten without any further culinary process. It is probable that thorough boiling would destroy the putrefactive process, and, if it did not remove the poison, would at least modify its mode of action. Prof. Liebig, indeed, says, that boiling water and alcohol completely destroy the poisonous properties of the sausages, without themselves acquiring similar properties. It is also worthy of mention, that Baron Liebig suggests the possession of alkaline or neutral properties, as the reason why the contagious matter of special diseases may be received into the stomach with impunity, whilst the poison of sausages, having an acid reaction, retains its dangerous properties under the same circumstances.‡

Poisonous sausages.

Reason assigned by Liebig why contagious poisons do not act when received into the stomach.

RÉSUMÉ.

The result of my investigations may be briefly summed up as follows :—

I. *Pulmonary murrain.*

I.—1. The cattle disease I was desired to investigate is not of recent origin, but has prevailed among the horned cattle of the United Kingdom for the last fifteen or sixteen years.

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* *Journal de Pharmacie et de Chimie.* August 1842. Guy's Hospital Reports, Second series. Vol. i. p. 11.

† Christison on Poisons, p. 585; also Dr. Dann *De Veneni Botulini viribus et Natura.* 1828. "Edinburgh Medical and Surgical Journal," xxxiii. p. 28.

‡ Liebig's Chemistry of Agriculture and Physiology. Third Edition. pp. 336, 337, and 375.

2. It is not peculiar to London, but is generally prevalent in country districts, and among cattle in pastures as well as in those that are exclusively stall-fed.

3. It is probably infectious, but is also developed spontaneously in consequence of some unknown peculiarities of breed, management, season, or locality, and is not supposed to have been imported into the United Kingdom.

4. It is identical with the *Lungenseuche* or pulmonary murrain now or lately prevailing in Mecklenburg, Holstein, and other continental countries.

5. It has no affinity with the disease called in Germany *Rinderpest* or steppe-murrain, with which it has been often confounded by writers in this country.

II.—1. Steppe-murrain is probably more highly contagious than pulmonary murrain, and is said only to originate spontaneously among cattle of the Podolian breed, and in the steppe countries of Southern Russia. II. *Murrain on the continent.*

2. Steppe-murrain is probably at present not more than usually prevalent in the south-eastern countries of Europe, and has on former occasions often prevailed more extensively than now in Austria and Prussia.

3. The only probable chance of the importation of steppe-murrain into the United Kingdom is by way of Prussia. It has recently shown itself at a few places only on the eastern frontier of that country, and has in each case been speedily exterminated by the active measures adopted by the authorities to secure its extinction.

4. The regulations enforced by the authorities to exclude steppe-murrain from the Prussian territory, and to extinguish it when it is imported thither, are of so stringent a character as to render its introduction into the United Kingdom by way of Prussia unlikely.

5. Any measures which it may be considered necessary to adopt for the exclusion of this disease from the United Kingdom must necessarily be of a permanent and not of a merely temporary character, as steppe-murrain is always more or less prevalent in countries adjoining to the eastern frontiers of Austria and Prussia. Perhaps the case would be satisfactorily met if the importation of cattle were prohibited, except from countries which, as regards steppe murrain, have clean bills of health and require similarly clean bills from other countries importing to them.

III.—Meat derived from animals suffering with pulmonary murrain, and probably with other diseases, is commonly and extensively sold both in London and elsewhere for human food. III. *The sale of diseased meat.*

IV.—1. There is no satisfactory proof that the consumption of meat derived from diseased cattle, has in this country been productive of direct injurious consequences upon those who have eaten it. IV. *The effects on human health of using the flesh of diseased animals.*

2. There are reasons for supposing that the use of meat from animals suffering from diseases unknown among the cattle of

the United Kingdom has abroad frequently been attended with serious consequences on human health.

3. The consumption of meat undergoing decomposition has frequently been injurious, and such meat cannot be eaten with safety even when cooked.

SUGGESTIONS.

The inquiry only of a preliminary character.

In concluding an investigation which was, from the first, only designed to be of a preliminary nature, with a view to such further steps as the circumstances might render necessary, I beg, in reference to such further proceedings, to observe :—

1. As regards steppe-murrain.

1.—That any investigation into the nature, history, and causes of steppe-murrain, which should consist only in collecting information from the veterinarian practitioners of the countries where this disease prevails, is unnecessary, as full reports on the subject are already accessible in the writings of Lorinser and other German authors.

2. As regards pulmonary murrain.

2.—That if it be considered right to investigate more completely the history of pulmonary murrain and the circumstances under which it has prevailed, for the purpose of elucidating its causes and of discovering some method of prevention, the inquiries must be conducted in a much more extensive field of observation than that afforded by the cow-sheds and dairies of the metropolis and its immediate vicinity. The results of the present investigation are only of a negative character ; but they show that if any benefit is to be obtained from a further inquiry, it can only be from a systematic investigation of the disease by professional observers, skilled in the study of disease, acquainted with the management and pathology of cattle, and carried out under one general superintendence.

3. As regards the consumption of unwholesome meat.

3.—That the effect on human health of consuming the flesh of diseased animals has been only partially considered in the present Report ; partly from the difficulty of obtaining accurate and reliable data, but also because only a very small section of the subject fell legitimately within the limits of my commission.

Conclusion.

It remains for me now only to express my sense of the courteous and valuable assistance most cheerfully accorded to me in the course of my inquiry by every person of official position from whom I have had occasion to seek information. I am also indebted to several private individuals for valuable assistance. I beg particularly to record my obligations to my friend Dr. Whitley, Medical Registrar of Guy's Hospital, for collecting for my use many interesting facts from German authorities.

I have the honour to be,
Sir,
Your obedient servant,

E. HEADLAM GREENHOW, M.D.

APPENDIX.

No. I.

Symptoms of Pulmonary Murrain, extracted from *Pleuro-Pneumonia among Cattle*, by George Waters, jun., M.R. Coll. Vet. Sur.—*Journal of the Royal Agricultural Society of England, Vol. IX., pp.* 344–6.

The first and most constant symptom of this disorder is a cough of a dry or husky character, which may continue for a greater or less period before other symptoms of a more decided nature present themselves. The frequency and severity of this cough may be influenced by circumstances: for instance, I have observed when the animal is fed exclusively upon hay, straw, &c., or when it is lodged in a close ill-ventilated hovel, or turned into a low, damp, marshy spot, the cough has become aggravated, and other symptoms of the disease have more speedily presented themselves. Again, the age and condition of the animal appear to govern its duration in this stage of the disorder: I have observed it, in young and well-conditioned animals, to continue longer than in those which are old and emaciated.

I will now inquire what modifications of the healthy sounds may be detected in the chest in this stage of the malady. In the majority of instances no morbid sounds have been discovered; but I have occasionally found a crepitation or rattling along the upper borders and bases of the lungs. In some cases the animal has been noticed to cough up now and then, and discharge by the mouth a thick mucous secretion.

I consider that the occurrence of this cough is an index to the commencement of a mild character of bronchitis, and which may exist for some time previous to the lung or pleura becoming diseased. Those symptoms which generally exhibit themselves at the time when the services of the veterinary surgeon are usually required, and which I consider indicate the second stage of the disease, are the following; for the better description of which I will instance a milch cow. If in a meadow with others, she is observed to separate herself from her companions and to be generally lying down whilst the others are feeding, with an aspect spiritless and haggard, staring coat, surface of skin rigid, and almost immoveable over the ribs, increased temperature of horns, muzzle dry, back somewhat raised, head projected forwards and inclined downwards, impaired appetite, and rumination partially or totally suspended; pulse increased in frequency and oppressed, pressure on ribs and spine produce flinching, respiration quickened, and accompanied by a peculiar grunting and grating of teeth; which symptoms of pain are aggravated upon coughing, as also upon any alteration of the position of the animal; decreased secretion of milk with alteration of colour, being usually of a yellowish cast; it sometimes coagulates when boiled; tenderness of udder and teats upon being milked; bowels costive, and, when moved, the fæces are hard and lumpy; urine scanty and paler than natural; cough short and frequent, and increased upon exertion.

Upon applying the ear gently to the sides of the chest, so as not to frighten the animal, one or other is found to be affected, and the right much more frequently than the left—sometimes, though rarely, both are implicated—but whichever lung be affected, the respiratory murmur in the other becomes louder and coarser than usual; the sound on percussion is natural.

On the affected side, if the pleura should be inflamed coincident with the lung or a portion of it, a peculiar crackling or fine crepitus is audible; this is limited to a small space in the beginning; but as the disease advances it becomes more diffused: this crepitus at first may be mingled with the ordinary respiratory murmur, which it nearly obscures; as the inflammation advances, it becomes more and more decided, until at length no respiratory murmur whatever can be heard throughout the part or parts occupied by the crackling. As the morbid action proceeds, the crepitus gradually disappears, giving place to other sounds: one of a puffing or blowing description may be heard during inspiration, as if confined to the bronchial tubes, and when the animal grunts or coughs the sound is conveyed directly to the ear. These sounds are most distinctly heard when the inflammation is confined to the upper and anterior parts of the lung, and when no effusion has taken place into the cavity of the pleura.

At the same time, and in variable spots, another symptom presents itself to the ear, viz., that of friction or rather creaking: this sound may be heard both on inspiration and expiration, but is more pronounced during the former; it is very inconstant, both as regards its duration and locality; for in-

stance, we have heard it most distinctly in one particular spot one day, when no trace of it could be detected in the same place on the following.

On striking the affected side at this stage of the complaint a dull sound is usually elicited to a greater or less extent; but this will depend upon the amount of lung that has become inflamed, and the presence or absence of fluid in the chest.

These sounds offer various modifications accordingly as the pleura or substance of the lung itself is most inflamed; thus, if pneumonia predominates, the creaking is but slightly if at all heard, and the dulness on percussion is not so flat and general; while, if a larger proportionate amount of pleurisy exists, bronchial respiration, bronchophony, and the rubbing sound may be heard, while little or no crepitation is audible; a marked difference is also observed on percussion, the dulness is more defined and dead, and principally confined to the lower parts of the chest owing to the presence of fluid, which, in all cases we have examined, has become rapidly and abundantly effused when much pleurisy existed.

Should the animal survive this state, which it seldom does, the third and last stage of the disorder now rapidly sets in, and we may be certain of its existence when we observe a death-like appearance in the aspect of the animal; the surface of the skin becomes cold and moist; coldness of horns, ears, and extremities; head still projected, with nose thrust into a corner, if in a hovel or stall; extreme restlessness; while she stands, which she frequently does, her fore-legs are placed wide apart, while her hind-legs are crossed one over the other; she is heedless of the approach of any one; respiration is rapid and intensely laborious; fœtid breath; there is a dirty-coloured viscid fluid occasionally mixed with purulent looking matter, discharged from the mouth; no secretion of milk; pulse rapid and weak, sometimes intermittent; extreme emaciation and prostration of strength, with inability to cough or swallow. In the majority of cases no sound whatever is heard on the diseased side, except a loud gurgling, which is audible at some distance; general dulness on percussion. This condition may continue for a few days, when she becomes reduced to a mere skeleton; at last her groans grow louder and more frequent; she makes ineffectual efforts to breathe from apparent suffocation; total insensibility sets in, which is quickly followed by death.

No. II.

Translation.

Pulmonary Disease in Cattle.

Peripneumonia Exudativa Contagiosa. By Dr. Warnecke, of Kiel. Inclosed in Mr. Vice-Consul Iven's Despatch of March 30th, 1857.

The malady consists of an inflammation of the parenchyma of the lungs, with considerable exudation of a plastic nature in the cellular structure. By its very contagious nature it is destructive, and has obtained the designation of malignant pulmonary disease. Whatever variety of opinions may have been published in recent times on the nature of the malady, what is stated above prevails here in the country universally. As belonging to the inflammatory class (*phlogosen*), the malady follows the character of the family, and is sthenic or asthenic, according to the constitution of the animal, &c. These modifications occur as in other inflammatory diseases (*phlogosen*). It is very difficult to make a definite diagnosis of this malady when it first happens to an animal. This is difficult for the scientific veterinary surgeon, who has much experience in the sort of disease, but far more so, even impossible, to the non-medical man.

The symptoms are the same as in the non-contagious pulmonary maladies. The premonitory symptoms are a dry, sharp cough, which in cases of feeble constitution may rather be termed a gasping (*keuchen*); the cough becomes subsequently more frequent, as in taking food, or drinking, or in moving. The beast shrinks from a pressure on the back, and it shows, by bellowing and bending down its back, the pain which this causes. The cough becomes continually worse and more painful; the breathing is accomplished with strong and short sudden movement of the flanks, *connected with a peculiar quick moaning;* the beast stands with its fore knees far out from its body; the hair is rough, dead, and without polish; the natural heat of the body is unequally distributed, and wholly gone in the extremities. The circulation is gradually more rapid, but the pulsation does not become bounding at the same time, nor hard. Auscultation shows us, by the cessation of the sound of the breath on one side, that the seat of the malady is on that side. After six to eight days the symptoms increase to their highest. The breathing becomes ex-

ceedingly difficult, and is effected with outstretched neck and head; the nostrils are dilated; the back is at the same time hollowed; the fæces are either stopped entirely, or else thin and fetid. Urine is seldom passed; it is dark, and deposits sediment. The beating of the pulse and heart continually increases in quickness. The animals get thin with extraordinary rapidity; cows in calf miscarry; in individual cases watery tumours (œdema) appear. The animal lies down, soon gets up again; it foams at the mouth in breathing; the diarrhœa is exhausting; tympanitis and meteorismus supervene; life ends.

Duration.

The duration of the malady is from two to ten days; it differs according to the constitution of the animal and the treatment.

Dissection.

In opening an animal that has died of the malady, or has been killed immediately after seizure, the muscle and fat is found but little altered. The same may be said in many cases of the posterior organs of the body. But the cavity of the chest shows us the existence of the malady there more clearly than in almost any other malady, if there had been any doubt during life. The exuded plastic stuff is found there in such large quantities that the cavity is wholly filled with it, from the mediastinum to the pleura. Such a lung will weigh from 20 to 52 lbs. Hamburg weight. If the lung be dragged out from the cavity, to which it clings with force, and cut through, the cut surface appears marbled, yellow, rose red, violet, dark red; the lung crumbles easily. Usually one lung only is attacked, while the other is healthy. In dissecting cattle that have died of the malady, if the disease did not proceed with violence, we find one lung somewhat *firmer* and harder than the other; but if the malady had gone far, and the treatment was bad, so that it was left to the healing force of nature, large capsules are then found in the lung, either empty or filled with pus. No doubt can well exist but that this pus would have brought on a renewed attack at a later period.

Ætiology (Causes).

It becomes every day more evident in this country that the pulmonary disease is not indigenous here; that it has not developed itself spontaneously here, but that it owes its presence *entirely* to contagion arising from the importation of *foreign* cattle.

Contagion.

The matter of contagion of the pulmonary disease is both fixed and fugitive; when there is no wind, the latter retains its capability of contagion within a circle of 100 paces radius, but may be carried still further by *porous* woollen stuff, &c. The fixed matters of contagion are,—the mucus from the nose, the excrements, the remains of carcases; they retain their power of contagion very long.

Treatment.

Here in this country, the question of treatment hardly ever arises, because the beasts attacked by the pulmonary disease, as well as all those that have been in contact with them, are by law slaughtered immediately. The State affords a compensation for such slaughtering of the cattle attacked by the disease, three-fourths of their estimated value; when in cutting up they are found to be healthy, then it pays the full estimated value. It is true, that this is a costly measure, but it is the most useful, as the contagion is stopped by it as far as possible. Under curative treatment, indeed, from 40 to 60 per cent. of the beasts attacked will sometimes be restored; but the danger of spreading the contagion is augmented three or fourfold. In those countries where the State pays no compensation for the losses caused by the pulmonary malady, and where consequently it does not require the cattle attacked to be slaughtered, a pure antiphlogistic method has proved to be the most advisable at the commencement of the disease, and afterwards the daily administration of from ʒi to ʒiss. ferri sulph. in three doses, in a decoction of linseed.

In regard to inoculation and its results, there has been no experience in this country.

The whole of western Holstein, the marshland especially, is at present to be considered as infected, while the eastern part has remained wholly free. The reason of this is, that the marshes are in constant intercourse, as to barter of cattle, with the Altona markets, and therefore with foreign countries, whereby a door is opened and a way made for the contagion.

Precautions.

The avoidance of contagion; the slaughter of infected beasts; the prohibition of keeping cattle by those whose cattle have been slaughtered, during ten weeks after the last case occurring; the disinfection of stalls vacated by slaughtering; the closing of infected places to all passage of cattle;

especial attention to the removal of the dung and of the remains of carcases of slaughtered beasts; and finally, undeviating severity of the law against infringement, with a strict supervision of those officials who are entrusted with the execution of the measures directed by the State to be taken against the spread of the pulmonary disease.

(Signed) D. Warnecke,
Veterinary Surgeon to the General Cattle Insurance Company for Denmark.

Kiel, 29th March 1857.

No. III.

Translation.

Report respecting the Pulmonary Disease now prevailing among the Horned Cattle in the neighbourhood of Hamburg. By G. W. Schrœder, Veterinary Surgeon to the Government of Hamburg, being Enclosure No 1, in Despatch dated 1 April, 1857, from Col. Hodges, C.B., Her Majesty's Consul-General at Hamburg.

The pulmonary disease among the horned cattle is a disease so generally prevalent that there are only few countries in Europe where it has not existed at times, more or less, and there are few veterinary surgeons, particularly in places where cattle are abundant, who are not acquainted with it from personal observation. Even in England this disease has been known in various parts during the last ten years, as appears from the reports of the English newspapers, and of the London journal, the "Veterinarian." The books written on the subject of the pulmonary disease would fill a small library. But it should not be confounded with the "Rindviehpest," *the Murrain*, as it is called in England.* Both are contagious diseases, but not akin to each other. The care and energetic measures of the Prussian government have prevented the spreading of that most dangerous disease, the "Murrain," which appears to have had its origin in the steppes of Southern Russia; for though, during the late war between Russia and Poland, several cases appeared in different districts near the Prussian frontier, the further spreading was soon stopped by the precautions taken. The pulmonary disease, as already mentioned, being generally known, I think I may limit my remarks to a short report, the more so, as the symptoms may vary in some respects, though, in general, they will be everywhere the same.

The symptoms in the first stage of the disease, from the taking or first attack, are so little peculiar, they are similar to those of any other febrile attack. In general, a slight cough may be observed for some time; then, if the disease increases, the fever augments and the respiration becomes accelerated, accompanied by violent coughing, but without throwing out mucus.

Milch cows give little or no milk at this period of the disease, and cows with young frequently slip their calves; and, on striking the breast, the places may be ascertained where parts of the lungs have already become hardened and adhere to the ribs.

In the last stage of the disease the restlessness and pain of the animal increase to the highest degree; it often lies down, but soon gets up again, and refuses to take food; knotty swellings will appear under the flanks; the dung is watery, and the belly collapses, though sometimes it swells with wind. Under these circumstances death soon takes place. On dissection water is generally found in the cavity of the breast, and one lobe of the lungs is partially or totally hard, and, if cut through, has a marble-like appearance. Other appearances on dissection are too rare to need mention here.

As to the treatment of this disease nothing satisfactory can be proposed. Various modes of treatment have been tried, sometimes with a very favourable result, but which in other cases did not succeed, and were, therefore, soon abandoned. The same may be said as to inoculation, which latterly has been highly praised by different persons; and it seems but right to await further impartial observations made during a course of years before any decisive opinion can be given with respect to the value of this proposed remedy. Bleeding, likewise, has not always succeeded, but issues and powerful embrocations on the sides of the breast have been resorted to by all veterinary surgeons. Of course, the state of the animal, and the nature of the disease, must be taken into account before applying these various remedies, which, therefore, must be attended with different results.

All proposed remedies for this contagious disease having been attended with doubtful

* The *Rindviehpest* is the same disease as *Rinderpest*, so frequently mentioned in the foregoing Report. The term *murrain* is not exclusively used to designate any particular disease, but is applied indiscriminately to all pestilential epidemic diseases among cattle.

E. H. G.

and unsatisfactory results, nothing will avail to get rid of it, or to prevent its further spreading, but the keeping off contagion by isolation, closing the stalls where it has broken out, or slaughtering the herd of cattle of which one has been attacked by the disease. Experience shows that animals coming from such stalls, though they have been examined and found quite sound in appearance, may propagate the disease several months afterwards.

In Hamburg, therefore, a notification has been issued directing that no cattle shall be brought in if they are not accompanied by official certificates, stating that the disease in question has not prevailed for the last six months at the places whence they come.

In the neighbourhood of Hamburg, the pulmonary disease prevailed at Altona and Oltensen, in Holstein, during the whole of last year, and all exertions to get rid of it have proved in vain. At other places in Holstein the disease appears to have been got rid of. Hanover, like Hamburg, has prohibited the importation of cattle from Holstein and Denmark.

Hamburg, March 30th, 1857.

(Signed) G. W. Schrœder,
Veterinary Surgeon to the Government of Hamburg.

(Signed)
T. C. Blumenthal,
Chief of the Hamburg Police.

No. IV.

Report on the Lung Disease in Cattle. By G. P. A. Hansen, Veterinary Surgeon. Inclosed in Mr. Vice-Consul Bird's Dispatch from Flensborg, of April 6th 1857.

Nature and Infectiousness.

The lung disease is contagious, *i.e.*, it developes a power of infecting.* It attaches and extends itself not alone by material objects (such as stalls, fodder, persons, and cattle, which either come in contact or within the influence of the exhalations from the diseased cattle), but also transmits itself to a limited distance through the air. Experienced practitioners estimate the range of its influence at about 80 paces. It is generally supposed that an infected object, for example, a stall, is capable of transmitting the disease, even several months after having been used for affected cattle, and upon this point we have no particular data to go upon. The disease is often transmitted by butchers who go from one stall to another; it has also been so on an estate in the south of Holstein, by a butcher from Hamburg.

It is considered probable that the grass meadows and the water retain the power of infection for some time, but nothing certain can be said on this head.

The disease commences with general uneasiness (allgemeinleiden), and in character depends upon the nature of the attack (sthenic, asthenic), but settles sooner or later upon the lungs.

At what stage this general uneasiness (allgemeinleiden) commences, and whether during its continuance the cattle so attacked are able to infect others, is uncertain. It can, however, be proved that as soon as the disease has begun to affect the lungs it is contagious; that cattle which were removed from infected herds got the disease after 12 weeks; also that the lung disease broke out among the other beasts, in stables to which such cattle, or even convalescent cattle, were brought.

Convalescent cattle infect others several months after their apparent recovery, and they have been known to have a second attack of the disease.

The principal means by which the disease is transmitted from infected beasts are, the breath, the exhalations from the skin, and the natural excrements; and it is therefore dangerous to allow infected cattle upon the roads, &c., where healthy cattle are driven. It is possible that some beasts may have a certain predisposition for the disease, for it is certain that some beasts have been exposed to infection without really being attacked. Thus among a number of diseased beasts there may be some which remain quite healthy, and again, only one beast may be attacked out of the entire stock. Cattle can also be attacked by the disease irrespectively of infection, and it is presumed that the following are the principal causes:—Cold, dampness, marshy grazing ground, bad drinking water, spoiled fodder, ill ventilated and unclean stalls, an excessive proportion of watery food, &c. However, in Schleswig these causes are so exceptional that they could neither produce nor maintain the disease. It can be pretty clearly shown by facts that the disease has always been introduced here from abroad, *viâ* Hamburg, or Altona, and then propagated by occasional cases of infection. This is proved by its having first shown

* *Entwickelt einen Ansteckungsstoff*, developes contagious matter.—E. H. G.

itself near Altona, and by its gradual extension towards the north; by its repeated suppression and subsequent reappearance from the same quarter; and by its appearing principally in those districts where an active cattle trade exists. Thus in the year 1842 it showed itself in and near Altona; in September 1843 the importation of cattle over the frontier at Altona was prohibited, and all infected cattle were killed; after some years the disease was entirely suppressed.

In 1847 it appeared for the second time in the neighbourhood of Altona; in 1849, 1851, it again showed itself there, extending to Pinenberg, Uetersen, and other places in the south of Holstein.

In some of the cases it appeared probable that the disease had been introduced by cattle imported from Hamburg, and in one case by a Hamburg butcher. In 1851 it extended to some few places in the south of Schleswig; Husum, Bredstedt, Lügumkloster, Tondern, Flensborg, and unto two miles (nine English) from Flensborg; subsequently also near Eckenfiorde (Altbulk and Birkenmoor), but soon vanished entirely from here in consequence of the stringent regulations adopted. In 1853 it was quite gone.

Altona and the south of Holstein were the districts where the disease again became prevalent in 1856, and it then extended also to the Holstein marshes. In February 1857 it appeared for the second time in the Eiderstedt district, though only on two or three estates, but was again lost sight of on the re-introduction of the Government regulations. Even in Holstein the disease has never been general; for example, during the summer half year of 1856, only 180 beasts were killed, and those for the most part merely suspected cattle.

The Symptoms.

The symptoms of the disease depend upon the degree of its development, and are passed through sometimes quickly, sometimes slowly; sometimes it shows itself lingeringly, sometimes violently, sometimes with evidences of violent fever, &c., sometimes without. Its first appearance is made known by a loud hard cough, which often appears to leave off periodically, returning with greater violence; then becoming more painful, shorter and drier; fever sets in; the hair stands up on the belly and back; the breathing gets quicker, amounting to gaspings interrupted by cough; the appetite becomes changeable; and the fore legs are placed wide apart. These symptoms shortly increase in intensity; pregnant cows miscarry; a violent diarrhœa takes place; and in a few days the beast dies of suffocation.

Sometimes the disease does not go so far, but slowly becomes milder, and, after some weeks, appears to be gradually passing away. Beasts which thus have the disease do not thrive for a very long time after. The symptoms are not sufficiently peculiar to establish the existence of the lung disease, except to a veterinary surgeon, for the same symptoms appear in cases of inflammation of the chest and lungs, lung apoplexy, dropsy in the chest, French sickness (perlseuche), &c. A more decisive proof is given, if several beasts of a herd sicken at or about the same time; and especially by the condition of the lungs after death, for in this disease the lungs assume a very remarkable appearance. The chest, lungs, and various parts of a cow's lung are enveloped in the same serous covering, the breast skin (pleura?).

As the seat of the disease is at this part, there are here shown the symptoms usual in all cases of inflammation, viz., the sweating out of a plastic lymph. The inflammation, however, very rarely extends over the whole breast skin, but is generally confined to a space about as large as a fist, invariably beginning in the lung itself.

On this account a section of such a diseased lung always has a marbled appearance—dark red to grey being produced by the colour of the lung, and yellow and bright red by the colour of the lymph and of the lung skin. No other disorder in the lungs causes such an appearance; and this may therefore be assumed as a decisive symptom of the lung disease. Sometimes, also, the lung becomes enormously heavy (the lung of one side weighing 20 to 50 lbs.); the lung grows fast to the coat of the ribs; water overflows into the windpipe; and boils may be present in the lungs, but are not characteristic.

The disease is not contagious for human beings or for any other animals, and the flesh of even diseased cattle is wholesome, the sale of such flesh being permitted by the Danish government, if it is otherwise fit for food. Thus at Altbülk in 1852 the flesh of 117 infected cattle was sold by auction to butchers. The degree of disease can only be determined by the extent of the inflammation in the lungs. Sometimes it appears with no other perceptible symptoms than a stubborn cough, erection of the hair on the belly and back, bad condition and reduced secretion of milk, leaving the beast after six weeks to 12 weeks in perfect health; at other times it runs its course in four to eight days, and is most violent in its operations.

Prevention.

Those who are acquainted with the nature and danger of the disease will be in no doubt as to the best means of preventing it. Wherever it has not become general, an [inspection and physicking proves but a poor prevention:*]—1st. Because the danger of infecting other herds is always very great unless the communication both with man and beast is entirely cut off. 2nd. Because such an [inspection] of considerable herds is attended with great expense and loss. 3rd. Because a large proportion of the herd would nevertheless be sacrificed. And, 4th. Because a perfect cure cannot possibly be effected in less than four to six months. Therefore, the course adopted by the Danish government appears the best adapted to suppress and prevent the disease, namely, immediately to kill all affected cattle, and temporarily to isolate those suspected. With respect to the removal of diseased beasts, it should only be allowed on such roads where it can be proved that during six weeks, in a circle of half a mile (2¼ Eng.), the lung disease has not appeared.

With respect to healthy cattle, immoderate exertion, spoiled fodder, bad water, too close packing in vapouring stalls, unclean iness in the stalls (the dung not being removed), and also bedding the cattle on wet straw, must be carefully avoided; when cattle are at grass on marshy cold land, a watchful eye should be kept on the beasts, and the surface water should be carried off by ditches, drains, &c. The most effective means of preventing the spread of the disease in Schleswig is, however, undoubtedly the prohibition of the import of cattle from Holstein to Schleswig; for notwithstanding that this must necessarily cause great injury to the trade and the graziers, experience has clearly enough shown us that the disease has always come from the south; and it is my conviction that by rigorously maintaining the prohibition the disease will soon be banished from Schleswig.

Extirpation.

The Danish government by its present prohibition has shown us the best way to drive out this disease. The regular course of the Danish cattle trade is from north to south,—from Jutland and Schleswig to Holstein and to foreign countries. Hamburg, however, is a market where meat and cattle are collected from all parts, forming, therefore, a hot-bed for the disease as long as it exists; and by the intimate connexion of Hamburg with Altona the disease is started northwards and spreads to Holstein. If, therefore, the intercourse with cattle is entirely cut off at the most northerly part of the country, and where the disease does not exist, the danger of a general extension cannot be great. In districts where the disease is not general, it is also proper to kill all diseased and suspected cattle immediately, for the compensation is insignificant when compared with the damage which might be occasioned; by a general extension of the disease 50 to 80 per cent. are usually lost. A cure should only be attempted under circumstances where a further spread of the infection is scarcely possible; the means then recommended are a strong antiphlogistic; and according to Kœnig, strong doses of iron vitriol repeated daily; and according to Leer, homœopathic doses of phosphorus. The best means, however, are to be found in the police regulations, and in cutting off all communication with dangerous places.

Gerlach says,—'The lung disease always yields to police regulations; whole districts as well as individual farms, where the disease had existed for several years, have invariably been freed from it within a twelvemonth on the prescribed measures being rigidly carried out. Inoculation can be tried as a preservative in districts where the disease is very prevalent. The results are reported to have been as follows: out of 6,864 head on which it had been tried, it succeeded in 5,434 cases, and had no effect in 1,430 cases; 113 head died in consequence of the operation, and 118 head of the lung disease; in this country it has not been tried, and the data we at present possess are insufficient to lead to any definitive conclusion.

Police Regulations in Denmark.

The Danish government has always endeavoured to prevent the importation of cattle from the south *vid* Hamburg, &c., and in this country the most energetic means (such as killing all diseased and suspected cattle) have been adopted for the suppression of the disease. These means have also succeeded so far as to prevent the disease becoming general, and even repeatedly to get rid of it entirely; but it has always returned when the regulations have been relaxed.

On its first appearance in the year 1852, the authorities issued a circular, dated

* The translator appears to have read *Durchseuchung* as *Durchsuchung*, or otherwise to have misunderstood this paragraph. The meaning of the original in the first sentence is, that *the spread of the disease is not prevented by letting the murrain run its course under medical treatment in the herds first attacked*; but, for the reasons specified, must be prevented by the more decided measure of sacrificing the affected cattle. —E. H. G.

July 5th, which still remains in force, and is as follows :—

1st. All persons, amongst whose cattle appear such symptoms as may be assumed to be symptoms of the virulent lung disease, are hereby strictly enjoined immediately to separate from the herd all those beasts which appear affected. Notice of the case must then be given to the veterinary surgeon of the district, and also to the parish bailiff. The symptoms of the virulent lung disease, as above referred to, consist of a hoarse cough, which gradually increases, and more especially shows itself after the beast has drunk or been in motion, a reduced appetite, slow rumination, reduced smoothness of the coat, the hairs bristling up in various places, and lastly, when the above symptoms have lasted some time, fever sets in.

2dly. If the notices are not duly given as prescribed no claim for compensation will be allowed, and a fine of from 10 to 50 Rdlrs. (1*l.* 2*s.* 6*d.* to 5*l.* 12*s.* 6*d.*) will be inflicted.

3dly. All cattle exhibiting symptoms of the lung disease shall be valued by the proper authorities and at once killed under the inspection of the district veterinary surgeon. The same course may also be adopted by the authorities as respects even suspected cattle, in cases where there is great danger of the disease spreading. After the beast has been killed, it shall be opened by the veterinary surgeon, and if it is found to have had the disease, the owner shall receive two-thirds of its declared value as a compensation; if not diseased, the full value shall be paid. The beast shall then, upon the veterinary surgeon's order, be buried with skins, entrails, &c., &c., at a depth of three to four feet, in some unfrequented spot.

4thly. Beasts which fall ill without exhibiting symptoms of the lung disease must for a time be carefully separated from the remainder of the herd, and be subjected to the veterinary surgeon's inspection.

5thly. Beasts which have had the disease, or which have stood or grazed with diseased beasts, are regarded as suspected, and must be subjected to the veterinary surgeon's special inspection. Such suspected cattle must be kept carefully separated, and cannot be regarded as healthy until 12 weeks have been passed without any appearance of the disease.

Beasts which have had a violent attack of the disease must not be put with healthy cattle until 18 weeks from the date when the illness began.

6thly. Every stall or other place where diseased or suspected beasts have stood, also all articles which may be suspected to retain the infection, must be carefully cleansed with boiling water, under inspection of the veterinary surgeon, and then repeatedly rinsed with a mixture of chloride of lime and water, or be subjected to the influence of steam from chloride of lime.

All iron-work must be made red-hot. Such places and articles must not be used for healthy cattle until the expiration of six weeks from the prescribed cleansing. Attendants upon diseased or suspected beasts must not approach healthy cattle; in cases where this cannot by any means be avoided such persons must scrupulously follow the instructions which will be given by the veterinary surgeon.

7thly. Grass lands on which diseased or suspected beasts have grazed must not be used for healthy cattle until the expiration of six weeks from the date when they were last grazed off. Fodder which has been exposed to infection must not be used for horned cattle, but it is harmless for other animals.

8thly. The fences and ditches round fields and fens where diseased or suspected cattle have stood must be carefully maintained in order to prevent infection of other beasts. If the fields and fens which are used for diseased or suspected cattle adjoin roads or other grass lands, proper means must be taken to prevent the cattle getting within a distance of 25 feet from such roads or other grass lands. If the suspected cattle are driven every day to and from the field, they must not be so driven upon roads used for healthy beasts. In fact, the removal of suspected cattle should, if possible, be avoided, and a fold be erected for them in the field.

9thly. Bulls which have served cows in suspected herds must not be allowed access to healthy herds.

10thly. The sale of infected beasts is not allowed; suspected beasts must not be sold, except by written permission of the authorities, and under strict observance of the precautionary measures which will be given by them. Owners of diseased or suspected beasts must scrupulously carry out the instructions given respecting them by the police authorities and by the veterinary surgeon.

Infringements of the regulations will be visited by fines of from 10 to 100 Rdlrs. (£1 2*s.* 6*d.* to £11 5*s.* 0*d.*)

These regulations also apply to such persons as have the care of cattle at grass, in all cases where the owner resides at a distance.

Other circulars have been issued, but they are of less importance, and in fact most of them have been recalled. With respect to the sale of the flesh of diseased beasts, the

following regulations were resolved upon at Altbülk.

1st. The flesh shall be salted at once, and laid in well-closed tubs.

2ndly. The flesh must not be used until Professor Ischerning shall have inspected and declared it fit for human food. A special payment shall be agreed upon for the hide and tallow of the beasts whose flesh cannot be eaten.

3rdly. The hides shall be salted on the spot, and sent to the tanners in closed tubs.

4thly. The slaughtering and the curing of the meat, &c., shall be effected as soon as possible after closing of the bargain, and at latest within 14 days.

The buyer shall defray all expenses.

5thly. The buyer shall carry out the instructions given by Professor Ischerning and Veterinary Surgeon Martinsen. The persons who have been employed at the slaughtering, the curing of the meat, &c., shall change their clothes when they leave the place where these processes are performed. The buyer shall give approved security for the payment, which shall be made to Baron von Plessen, upon delivery of the cattle to the slaughterers.

Flensborg, 1st April 1857.

(Signed) G. P. A. Hansen,
Veterinary Surgeon.

(True Translation.)

Flensborg, 6th April 1857.

(Signed) Edward Bird,
British Vice-Consul.

No. V.

Résumé Général des Expériences de la Commission Scientifique de la Péripneumonie.

Extracted from "*Rapport Général des travaux de la Commission Scientifique Institutée près le Ministère de l'Agriculture, du Commerce, et des Travaux Publics, pour l'Etude de la Péripneumonie Épizootique du Gros Bétail.*" pp. 72, 82.

La commission scientifique de la péripneumonie a institué deux séries principales d'expériences ayant pour but :

Les premières de rechercher l'influence que peut exercer sur l'organisme des animaux sains de l'espèce bovine leur cohabitation avec des animaux malades de la péripneumonie ;

Les deuxièmes d'étudier les effets de l'inoculation de la péripneumonie sur les animaux sains de l'espèce bovine, et surtout de reconnaître si les animaux, inoculés avec le liquide extrait des poumons d'une bête affectée de cette maladie, acquéraient par ce fait le privilége d'une immunité qui les mît à l'abri de la contagion.

Voici le résumé de ces deux séries d'expériences, et les conclusions auxquelles elles conduisent :

A.—*Expériences sur la Cohabitation.*

La commission, en instituant ces expériences, s'était proposé la solution des questions suivantes :

1° La péripneumonie épizootique du gros bétail est-elle susceptible de se transmettre, par voie de cohabitation, des animaux malades aux animaux sains ?

2° Dans le cas où la contagion de la péripneumonie s'opérerait par cette voie, tous les animaux de l'espèce bovine qui vivent dans un foyer d'infection, contractent-ils la maladie, ou en est-il qui resistent à l'influence contagieuse ? Dans ce dernier cas, quelle est la proportion des animaux qui deviennent malades et des animaux qui restent sains ?

3° Parmi les animaux qui contractent la maladie, combien récupèrent leur santé et dans quelles conditions ?

Combien succombent par la maladie ?

4° Y a-t-il des animaux de l'espèce bovine qui soient décidément réfractaires à la contagion de la péripneumonie ?

5° Les animaux de cette espèce sont-ils préservés à l'avenir des atteintes de la péripneumonie, lorsque à la suite d'une première cohabitation ils n'ont présenté que les symptômes d'une indisposition légère, caractérisés principalement par une toux plus ou moins persistante ?

6° Les animaux qui ont contracté une première fois la péripneumonie, ne sont-ils plus susceptibles de la contracter de nouveau ?

Pour obtenir la solution de ces questions la commission a soumis à différente, épreuves de cohabitation 46 animaux de l'espèce bovine, parfaitement sains, et dans de telles conditions de provenance qu'ils n'avaient jamais été exposés à l'influence du contact d'animaux atteints de la péripneumonie.

Ces 46 sujets d'expérience ont été répartis ainsi qu'il suit :

20 à la Pomeraye (première expérience) ;
2 à Charentonneau (deuxième expérience) ;

13 à Maisons-Alfort (troisième expérience) ;
11 à Charentonneau (quatrième expérience) ;
Sur ce nombre, 21 animaux ont paru réfractaires à la contagion, dans une première épreuve de cohabitation ;
10 ont éprouvé une indisposition passagère ;
15 ont contracté la maladie.

Total - - 46

Sur ces 15 malades de la péripneumonie, contractée par cohabitation, 11 sont guéris et 4 sont morts.

Conséquemment, le nombre des animaux réfractaires, en apparence, à une première épreuve de cohabitation, s'élèverait, à 45,65 pour 100.

Celui des animaux indisposés, à 21,73 pour 100.

Celui des animaux malades et guéris, à 23,91 pour 100.

Celui des animaux morts, à 8,69 pour 100.

Mais si, au lieu de s'en rapporter aux apparences extérieures des animaux exposés à la cohabitation, on prend en considération les résultats donnés par les autopsies, qui ont démontré que 6 des 11 animaux, mis en expérience à la ferme de Charentonneau (quatrième expérience), avaient contracté la maladie, on voit qu'il faut compter 6 animaux en plus, comme malades par suite de la cohabitation, et 6 réfractaires en moins, ce qui donne, en définitive, les résultats suivants :

15 réfractaires - -	32,61 pour 100.
10 indisposés - -	21,73 pour 100.
17 malades guéris	36,95 pour 100.
4 morts - - -	8,98 pour 100.
46	100,27

Sur les 42 animaux qui ont été exposés aux premières épreuves de cohabitation faites à la Pomeraye et à Charentonneau, et qui en sont sortis avec leur santé sauve ou recouvrée, 18 ont été soumis une deuxième fois aux mêmes épreuves, et sur ces 18, 4 une troisième fois.

Ces 18 animaux se décomposaient ainsi qu'il suit :

5 avaient contracté la maladie à la suite de la première cohabitation et en étaient guéris ;

9 étaient demeurés réfractaires à une première influence contagieuse ;

4 n'avaient été qu'indisposés par suite de la première cohabitation.

Quant aux 4 animaux qui furent soumis à la troisième expérience de cohabitation, ils faisaient partie de la catégorie de ceux qui avaient contracté la maladie par le premier contact, et qui en étaient guéris.

Aucun des 18 sujets soumis à ces nouvelles épreuves, dans ces conditions, ne contracta la péripneumonie et ne présenta même les plus légers symptômes d'indisposition.

De résultats de ces expériences de cohabitation, la commission a tiré les conclusions suivantes :

Conclusions.

1° La péripneumonie épizootique des bêtes à cornes est susceptible de se transmettre par voie de cohabitation, des animaux malades aux animaux sains de la même espèce.

2° Tous les animaux exposés à la contagion par cohabitation ne contractent pas la péripneumonie ; il en est, parmi eux, qui demeurent complétement réfractaires à l'action contagieuse, et d'autres qui n'éprouvent, sous son influence, qu'une indisposition légère et de peu de durée.

3° Parmi les animaux qui contractent la maladie, les uns guérissent et récupèrent après leur guérison toutes les apparences extérieures de la santé, et les autres succombent.

4° Les animaux qui ne présentent que des symptômes d'une indisposition légère à la suite d'une première cohabitation, paraissent préservés par ce fait, à l'avenir, contre les atteintes de la péripneumonie.

5° Les animaux qui ont été atteints une première fois de la péripneumonie, ne paraissent plus susceptibles de la contracter de nouveau,

Telles sont les conclusions générales que la commission s'est crue autorisée à déduire de ses expériences sur la contagion par cohabitation. Quant aux questions de savoir quelles peuvent être, dans un troupeau soumis à l'influence de la contagion, les proportions relatives des animaux qui demeurent réfractaires à son action ; de ceux qui deviennent indisposés ; de ceux enfin qui contractent la péripneumonie, et parmi ces derniers quel est le rapport des morts aux guérisons, la commission n'a pas pensé avoir réuni un assez grand nombre de faits, pour formuler une conclusion qui fût l'expression absolue de ce qui se passe dans les conditions habituelles de la pratique. Elle a dû se borner à énoncer ici les chiffres qui résultent de ses expériences particulières.

D'après le relevé de ces expériences, 45 animaux sur 100 ont contracté la péripneumonie par le fait de la cohabitation, et 21 ont éprouvé une indisposition légère ; ce qui fait, en résume, 65 animaux qui ont ressenti l'influence contagieuse à des degrés divers, et 32 qui s'y sont montrés réfractaires.

La proportion des animaux qui ont récupéré toutes les apparences extérieures de la santé, après avoir contracté la maladie, a été de 83 pour 100 des animaux malades, et celle des sujets qui ont succombé a été de 17 pour 100.

B.—*Expériences sur l'Inoculation de la Péripneumonie.*

Les questions que la commission s'était proposé de résoudre par ses expériences sur l'inoculation de la péripneumonie, étaient les suivantes :

1° La péripneumonie est-elle susceptible de se transmettre aux animaux sains par l'inoculation du sang, de la bave, de la matière de l'écoulement nasal, et des matières excrémentitielles provenant d'animaux affectés de cette maladie ?

2° Les animaux sains que l'on a soumis à l'inoculation de l'une ou de l'autre de ces substances, ont ils contracté, par ce fait, une immunité à un degré quelconque, contre l'influence contagieuse de la maladie ?

3° La péripneumonie est-elle susceptible de se transmettre, avec sa forme et ses symptômes caractéristiques, aux animaux sains de l'espèce bovine, par l'inoculation du liquide extrait du poumon d'une bête malade de cette maladie ?

4° Dans le cas où l'inoculation de ce liquide ne déterminerait pas sur les animaux sains une répétition exacte de la forme et des symptômes de la maladie inoculée, comme cela se remarque à la suite de l'inoculation de toutes les maladies contagieuses, quels sont les phénomènes locaux ou généraux qui en sont la conséquence ? Dans quelles proportions et avec quels caractères plus ou moins graves d'intensité ces phénomènes se traduisent-ils ? Combien d'animaux succombent aux suites de l'inoculation ? Combien récupèrent la santé après avoir été soumis à son épreuve, et dans quelles conditions ?

5° Les animaux de l'espèce bovine soumis à l'épreuve de l'inoculation du liquide pulmonaire, acquièrent-ils par ce fait, le privilége de résister à la contagion de la péripneumonie ?

Les expériences faites pour résoudre la question de la contagion de la péripneumonie par l'inoculation du sang, de la bave, du mucus nasal, etc.—n'ayant porté que 6 animaux, la commission n'a pas pensé qu'elles fussent assez nombreuses pour servir de base à une conclusion quelconque, aussi ne les a-t-elle fait enregistrer dans ce compte rendu que pour mémoire. Toutefois, la commission a cru devoir signaler ici cette circonstance, que les 2 vaches qu'elle a fait inoculer avec le mucus nasal, et qu'elle a soumises ensuite à lépreuve de la contagion par cohabitation, n'ont pas contracté la péripneumonie.

Les expériences d'inoculation du liquide extrait des poumons d'une bête affectée de la péripneumonie, ont été faites sur 54 animaux parfaitement sains, et dans de telles conditions de provenance, qu'ils n'avaient jamais été exposés à la contagion de la maladie.

En voici le résumé :

Des 54 sujets inoculés, aucun n'a contracté la péripneumonie par le fait de l'inoculation.

Sur 33, les effets de l'inoculation ne se sont traduits que par une inflammation légère et très-circonscrite ;

Et sur 21, cette inflammation, consécutive à l'inoculation, a été très-grave, très-étendue, et s'est compliquée de phénomènes gangréneux, dont les conséquences ont été mortelles pour 6 des sujets inoculés.

Conséquemment, le nombre des animaux sur lesquels l'inoculation a été bénigne, s'élève à - - - - 61,11 p. 100

La proportion de ceux dans lesquels la gangrènes s'est déclarée à la suite de l'inoculation et a déterminé la chûte de la queue, est de - - 27,77 p. 100

Et enfin, celle des morts est de - - - 11,11 p. 100

Donc 88,88 sujets sur 100 sortiraient des épreuves de l'inoculation avec leur santé sauve ou recouvrée, et 11,11 succomberaient à ses suites.

Des 48 sujets sortis sains ou saufs des épreuves de l'inoculation, 2 sont morts d'accidents étrangers à cette opération et 34 ont été exposés pendant une période de cinq à six mois à l'influence directe de la contagion par cohabitation, avec 24 sujets de même provenance non inoculés, devant servir de termés de comparaison.

12 animaux inoculés, qui avaient été placés dans une étable à part pour être utilisés à des expériences ultérieures, ne furent pas exposés au contact direct d'animaux malades de la péripneumonie, mais ils furent pansés par le même vacher qui était chargé du soin de ces malades.

Sur ces 46 sujets inoculés, un seul (soit 2 pour 100), habitant l'étable non contaminée, contracta la péripneumonie, tandis que sur les 24 animaux non inoculés, servant de termes de comparaison, qui furent soumis à l'influence directe de la contagion, en même temps que 34 des sujets inoculés, 14 (soit 58 pour 100), avec ou sans symptômes apparents, ont ressenti l'influence contagieuse.

Des résultats de ces expériences sur l'inoculation de la péripneumonie, la commission a tiré les conclusions suivantes.

1° L'inoculation du liquide extrait des poumons d'une bête bovine, malade de la péripneumonie, ne transmet pas aux animaux sains de la même espèce auxquels on la pratique une maladie semblable, tout au moins par son siége, à celle d'où procède le liquide inoculé.

2° Les phénomènes appréciables, consécutifs à l'inoculation, sont ceux d'une inflammation locale, légère et circonscrite au lieu de l'inoculation, sur un certain nombre des sujets inoculés; grave, diffuse, accompagnée d'une réaction générale, proportionnelle à l'intensité de la réaction locale, et la compliquée d'accidents gangréneux sur un autre nombre des animaux inoculés, pouvant enfin se terminer par la mort pour quelques-uns de ces derniers.—(Dans les expériences de la commission, l'inoculation a été benigne dans ses effets sur 61 pour 100 des sujets inoculés; grave et compliquée d'accidents gangréneux sur 38; mortelle pour 11. 88 sujets, sur 100, ont donc récupéré leur santé après l'inoculation; 61 sans présenter des traces apparentes de l'opération qu'ils avaient subie, et 27 avec des lésions extérieures locales, plus ou moins étendues et accusées, suivant l'intensité des accidents gangréneux auxquels l'inoculation avait donné naissance.)

3° L'inoculation du liquide extrait des poumons d'un animal malade de la péripneumonie possède une vertu préservatrice; elle investit l'organisme du plus grand nombre des animaux auxquels on la pratique d'une immunité qui les protège contre la contagion de cette maladie, pendant un temps qu'il reste à déterminer, mais qui dans les expériences rapportées plus haut n'a pas été moindre que six mois.

— Si maintenant, pour apprécier la valeur économique de l'inoculation dont l'expérience directe démontre les propriétés préservatrices, on voulait comparer les résultats que sa pratique a donnés dans les différents essais rapportés plus haut, avec ceux qui ont été fournis par toutes les expériences de cohabitation relatées dans ce compte rendu, voici les conclusions auxquelles ce rapprochement conduirait:

Du relevé statistique des expériences faites par la commission, il résulte d'une part:

Que sur 100 animaux de l'espèce bovine exposés à l'influence de la contagion par cohabitation,

32,61 sont épargnés, et

21,73 n'éprouvent qu'une indisposition passagère et de peu d'importance pour leur santé; considérable cependant, en ce sens favorable, qu'elle les prémunit à l'avenir contre les atteintes du mal;

Soit en tout 54,34 sujets, sur lesquels les effets de la cohabitation sont ou tout à fait nuls ou très-légers;

45,65 sujets contractent la maladie à un degré plus ou moins intense;

35,95 en guérissent, et

8,69 succombent aux suites de la maladie.

D'autre part, il résulte des expériences d'inoculation faites par la commission, que sur le même nombre 100 d'animaux soumis à l'épreuve de cette opération:

61,11 n'en éprouvent que des effets très-bénins; qu'elle est plus ou moins dangereuse, ou tout à fait nuisible par ses suites, pour 38, 88 sujets;

Que sur ces 38,88 sujets, 27,77 guérissent après avoir éprouvé des accidents gangréneux plus ou moins graves, et 11,11 succombent par suite de ces accidents gangréneux.

Le tableau suivant présente, en regard, les résultats chiffrés donnés par les deux expériences d'inoculation et de cohabitation faites par la commission:

COHABITATION.		INOCULATION.	
Le nombre des sujets d'expérience étant supposé	100	Le nombre des sujets d'expérience étant supposé	100
La cohabitation serait ou nulle dans ses effets, ou très-bénigne pour	54,34	L'inoculation serait bénigne pour	61,11
Et plus ou moins nuisible pour	45,65	Et plus ou moins nuisible pour	38,88
Dans ce dernier chiffre, la guérison serait représentée par	36,95	Dans ce dernier chiffre, la guérison serait représentée par	27,77
Et la mort par	8,69	Et la mort par	11,11
En résultat définitif, le nombre des animaux sortis des épreuves de cohabitation avec la santé *sauve* ou *recouvrée* s'élèverait, d'après ce relevé, au chiffre de	91,21	En résultat définitif, le nombre des animaux sortis des épreuves de l'inoculation avec leur santé *sauve* ou *recouvrée* s'élèverait, d'après ce relevé, au chiffre de	88,88
Et celui des morts à	8,69	Et celui des morts à	11,11

Le premier fait qui ressort de ce rapprochement, est que l'inoculation a causé une mortalité plus grande que la maladie dont elle avait pour but de prévenir les ravages.

En outre, il faut considérer que les animaux qui ont résisté aux accidents gangréneux consécutifs à la l'inoculation, ont perdu une grande partie de leur valeur vénale après leur guérison, parce qu'ls n'ont pu recouvrer leur santé qu'après un long temps de souffrance qui les a beaucoup amaigris, et qu'ils demeurent à jamais tarés et d'une manière difforme, par la perte d'une partie plus ou moins étendue de leur queue; tandis que, au contraire, les vaches qui, dans les expériences de la commission, ont contracté la péripneumonie et en sont guéries, ont récupéré à peu près leur valeur après leur guerison, la maladie n'ayant laissé

sur elles aucune trace extérieure appréciable, et n'ayant pas sensiblement modifié, par son influence, l'aptitude des animaux soit à la lactation, soit à l'engraissement.

Mais il est juste de dire, pour faire entrer en ligne de compte tous les éléments de la solution impartiale de cette grave question, que le plus grand nombre des animaux qui récupèrent les apparences de la santé après avoir contracté la péripneumonie ne guérissent pas complétement de cette maladie. Dans l'immense majorité des cas, ainsi qu'en témoignent les autopsies faites par la commission, une partie de leurs poumons, plus ou moins étendue suivant l'étendue de la maladie primitive, reste frappée d'une véritable mortification. Cette lésion demeure isolée, il est vrai, au milieu du reste de l'organe conservé parfaitement sain; il s'opère autour d'elle un travail remarquable de séquestration, en vertu duquel toute communication est interceptée entre les conduits aériens et la partie mortifiée qui échappe ainsi à la décomposition putride, et c'est ce qui explique comment une lésion de cette nature peut, malgré sa gravité apparente, n'être pas incompatible pendant un assez long temps tout au moins, avec la conservation des aptitudes de l'animal à l'engraissement et à la lactation; mais ce mode de terminaison de la péripneumonie ne peut pas, après tout, être considéré comme une guérison, dans le sens rigoureux du mot, et en définitive il est juste de dire que si, au point de vue économique, le plus grand nombre des animaux qui récupèrent la santé après avoir contracté la péripneumonie, n'éprouvent pas dans leur valeur vénale de dépréciation notable, ils n'en sont pas moins atteints de lésions assez graves d'un organe essentiel qui, au point de vue physiologique, ne laissent pas que d'avoir une grande importance, et qui peut-être finiraient par faire sentir leur influence, si la vie des animaux de l'espèce bovine se prolongeait davantage.

Doit-on conclure des résultats donnés par le relevé statistique des expériences de la commission, que l'inoculation ne saurait être conseillée dès aujourd'hui comme une mesure pratique à opposer à la propagation de la péripneumonie, et que les propriétaires de bêtes bovines auraient moins d'avantage à l'adopter qu'à laisser la maladie se repandre dans leurs troupeaux, suivant son mode habituel?

Non sans doute, car il faut considérer d'une part que les tâtonnements des premiers essais, les imperfections des premiers procédés ont pu grossir, dans les expériences de la commission, le nombre des accidents et des pertes que la pratique de l'inoculation peut entraîner, tandis que d'un autre côté le chiffre de 8 pour 100, qui dans ces expériences représente la mortalité causée par a contagion de la péripneumonie, est del beaucoup inférieur à celui qui exprime les pertes déterminées par la marche naturelle de cette maladie, dans les circonstances les plus graves et peut-être les plus ordinaires de la pratique; différence qu'explique sans doute la rusticité du plus grand nombre des sujets dont la commission s'est servis, dans ses expériences sur la contagion par cohabitation.

En définitive, quoiqu'il ne ressorte pas des expériences actuelles de la commission, que l'inoculation soit économiquement une mesure avantageuse; cependant, comme ces expériences paraissent démontrer sa vertu préservative, en présence de ce fait considérable, la commission est d'avis que la pratique de l'inoculation doit être encouragée, et elle a l'espérance qu'elle deviendra profitable à l'agriculture lorsqu'elle aura été perfectionnée, dans l'application, par une étude plus complète.

No. VI.

Notes on the Murrain which prevailed at Sinope, during the Summer and Autumn of 1855. By J. N. Radcliffe, Esq., M.R.C.S., lately attached to the Ottoman Army under the command of His Highness Omar Pasha.

A deadly murrain prevailed among the cattle in several districts in Asia Minor, during the summer of 1855. Towards the termination of the autumn and during the winter of that year, I was stationed at Sinope, and had an opportunity of ascertaining a few particulars respecting the murrain, as it prevailed in that town. My information was derived principally from the authorities in charge of the British Commissariat Depôt at Sinope, and from observation of the diseased cattle in the sheds of the Depôt, and in the town. I was unable to obtain the numerical data which were requisite to form a correct history of the outbreak of the murrain, its rapidity of extension, and its mortality; moreover, an attack of sickness brought my inquiries to a somewhat summary conclusion.

The murrain was developed towards the termination of spring, or early in the summer. I was foiled in my endeavours to obtain a trustworthy account of the earlier cases of the disease, but there appeared to be no doubt that, in the month of June, the murrain reached an acme, after which it rapidly declined. Scattered cases occurred, however, from time to time, until November, when, about the second or third week of that month, the disease broke out again with great fierceness, spread rapidly

among the cattle in the Depôt and in the town, reached a second acme about the termination of the month, declined during December, and ceased altogether in January, 1856.

The attack of the disease appeared to be invariably sudden, and the progress of the symptoms was singularly uniform. The animal attacked was seized with profuse diarrhœa; exhaustion rapidly followed, the animal sinking to the ground; the breathing became oppressed; a thick glairy mucus trickled from the eyes and nostrils; and death occurred within *nine* hours from the commencement of the attack,—the duration of the disease rarely indeed exceeded *six* hours.

The first symptom of the disease was characteristic. The animal would suddenly void from the bowels, in a thick stream, an enormous quantity of fluid matter, which was either of a pale yellow, or of a brownish colour. The evacuations invariably contained shreds and flakes of lymph, and generally, sooner or later, more or less blood. The most common appearance of the evacuated matter was that of a yellowish coloured fluid in which shreds of lymph were floating. Frequently, as the animal lay exhausted upon the ground, gouts of mucus streaked with blood would be seen in and about the anus.

I examined the carcases of four cattle that had died from the murrain. In the *first* case the animal had died after six hours' illness, and had been dead three hours when the examination was made. The *rumen*, the *reticulum*, and the *psalterium* were full of masticated oats and oaten straw, and the *abomasum* was full of partially digested food. The mucous membrane of the *rumen* seemed to be of a somewhat darker colour than usual. The *intestines* were full of a pale yellow or straw-coloured liquid, in which shreds of lymph were floating. The liquid in every respect, excepting the presence of the shreds of lymph, had the aspect of the partially digested food in the *abomasum*, excessively diluted, and there was an entire absence of fæcal odour. The *cœcum* and the whole of the *colon* were studded with patches of florid punctuated injection, and over many of the patches there was a layer of mucus, tinged or spotted with blood. The summits of the *rugæ* of the *rectum* were somewhat redder than natural; and in the contents of the *rectum* was floating a large thick piece of coagulable lymph, spotted with bloody points. The remainder of the viscera appeared to be in a natural state.

In the *second* case, the animal had died after six hours' illness, and it had been dead about half-an-hour when the examination was made. The *rumen*, *reticulum*, and *psalterium* were filled with masticated oats and oaten straw, and the *abomasum* with partially digested food. The intestines were filled with a pale yellow liquid, in which floated flakes of lymph, and which was precisely similar in aspect and character to that observed in the first case. The mucous membrane of the *colon* was studded with patches of florid punctuated injection, above which, in several places, blood was effused; and the *rugæ* of the *rectum* were red at the summits. The lungs were gorged with frothy mucus, but all other portions of the viscera were healthy.

In the *third* case the animal had been dead seven hours when the carcase was examined. The *stomach* presented the same appearance as in the first and second cases, except that a few patches of congestion were observed on the mucous membrane of the *abomasum*, near the orifice of communication with the *psalterium*. The intestines were full of a brownish coloured liquid, in which shreds of lymph floated, and which was free from fæcal smell. The mucous membrane of the *cæcum* and *colon* were studded with patches of florid punctuated injection; and the *rugæ* of the *rectum* were reddened at the summits. The *lungs* were gorged with frothy mucus.

In the *fourth* case the animal had also been dead about seven hours, and the appearances found on examining the carcase differed in no respect, except in the absence of congestion of the mucous membrane of the *abomasum*, from those observed in the third case.

In each case the patches of injection observed in the cæcum and colon were of a vivid colour, and they consisted of minute red spots, thickly grouped together. In no instance were the vessels of the sub-mucous tissue congested, so that they could be traced beneath the patches of injection; and in no instance could the position or existence of the injected patches be discovered by an inspection of the bowel externally. Externally the intestines in each instance had a healthy aspect from the stomach to the anus.

The fatality of the murrain was excessive —indeed, I did not hear of any instance in which an animal attacked with the disease recovered. The disease appeared to prevail with as much severity among the cattle in the town, as among those in the Commissariat Depôt.

The cattle-sheds of the Depôt were three in number. They were large and lofty, floored with wood, and well roofed, and each shed was capable of containing 320 cattle. The sheds were kept in excellent order, and they were very free from smell. Even in the morning, when the cattle were turned out to graze, the odour within the sheds was not so strong as might have been anticipated. Each shed was divided from

end to end into eight divisions; the cattle were arranged in four double rows, head to head, and between the feeding-troughs was a path for the attendants. A division also ran transversely across each shed, at the level of the feeding-troughs, and twenty cattle were arranged on each side of this division in the different ranges of stalls. The sheds were on a slope outside the suburbs of the town, near the sea, and they faced the south, being well sheltered from northerly winds. The cattle were fed night and morning on unthrashed oats, and the supply of water was good and abundant. Every attention was given to the ventilation of the sheds, but, notwithstanding this, the prudence of cramming so many animals into a single shed seemed to me somewhat more than doubtful, and during the prevalence of murrain the crowding would be apt to prove most noxious.

I got the impression that the animals were attacked with the disease more frequently during the night, or soon after being driven out of the sheds in the morning, than during other periods of the day, but my information was insufficient to enable me to form a trustworthy opinion.

The murrain, in the second outbreak, was not noticed to prevail more extensively among the cattle which had been recently brought from the country than among those that had been in the Depôt some time, but the data respecting this point could not be depended upon.

The measures adopted at the Depôt to check the murrain were, careful tending of the cattle, and the non-admission of fresh animals after the disease had fully broken out. No veterinary surgeon was attached to the Depôt at any period during the prevalence of the murrain.

During the summer the fatality was as great among the cattle which the Commissariat had collected in the country, at some distance from Sinope, as it was among the cattle in the Depôt. It may be added, incidentally, that while the murrain prevailed, both in the summer and autumn, few, if any, cattle were sent from Sinope to the Crimea.

The condition of the town, and of the adjacent country, during the prevalence of the murrain, was most horrible. The beach, the ditch, the base of the walls, the roads, the woods, the hill sides, and the open spaces were studded with putrifying carcases, and foul stenches assailed the nostrils on every hand.

It was reported that the murrain prevailed in several places contemporaneously with epidemic cholera. In Sinope two or three fatal cases of cholera occurred in November, and common continued fever prevailed to an unusual extent. The town, however, was not only in a filthier state than usual, but it was excessively crowded, from a large number of men attached to the Commissariat Depôt, and the Depôt of the Land Transport Corps being housed in it. Moreover the great demand for articles of food, in consequence of the increased number of inhabitants, caused the markets to be very scantily supplied, and the diet of the poorer classes was considerably impoverished.

In the autumn and winter a great mortality prevailed among the camels in the Land Transport Corps' Depôt, and the majority of them died. Powerful causes were, however, acting, which, of themselves, were sufficient to induce the fatality. For the camels were densely crowded together in sheds and pens; little attention was given to the cleanliness, and to the healthy and fitting situation of the buildings in which they were stabled; and it was suspected that the feeding was bad and insufficient from peculation by the native attendants. Among the remainder of the animals (some 7,000 in number) in the Depôt of the Land Transport Corps, no other disease than *mange*, so far as I am aware, prevailed epidemically, but there were scattered cases of *glanders*.

The acme of the second outbreak of the murrain was contemporaneous with wide and sudden oscillations, and a long continued *mean* depression of the barometer; with a comparatively high thermometer; and with a succession of heavy but brief gales, sharp squalls, and rapidly varying winds. The decline of the outbreak was contemporaneous with the formation of a barometric wave which commenced on the 14th of December, and terminated on the 12th of January.

From a series of barometrical and thermometrical observations which I made at the time, I was led to the conclusion that the great oscillations of the barometer, the storms, and the variable winds, which were observed about the period when the second outbreak of the murrain culminated, were probably due to a local atmospheric disturbance, Sinope being within the area of disturbance.

The double outbreak of the murrain at Sinope, and the uniformity of the symptoms of the disease, and of the pathological changes observed after death from the disease, seemed to me facts worthy of note, and although my notes are meagre, they may, nevertheless, suffice to induce others who have had more favourable opportunities of studying the progress of the murrain, to give their observations to the public,

Bramley near Leeds, December 1856.

I have great pleasure in acknowledging the assistance which I received, in making the foregoing inquiries, from Habeeb Risk Allah Effendi, M.R.C.S.L.

No. VII. RETURN showing the NUMBER of HORNED CATTLE exposed for Sale in the Metropolitan Cattle Market in the Years 1855 and 1856.

1855. Date.	Total Number of Beasts exposed for sale.	Number of Foreign Cattle included in first column.
January 5	5,288	410
„ 12	5,406	540
„ 19	4,885	433
„ 26	4,663	610
February 2	5,054	508
„ 9	4,441	705
„ 16	4,534	699
„ 23	4,295	615
March 2	3,639	684
„ 9	3,968	390
„ 16	4,842	210
„ 23	5,222	415
„ 30	4,691	249
April 6	4,652	401
„ 13	3,729	275
„ 20	4,193	165
„ 27	4,915	203
May 4	5,265	406
„ 11	5,255	190
„ 18	4,960	360
„ 25	5,245	710
June 1	4,728	796
„ 8	4,932	504
„ 15	4,724	117
„ 22	5,881	290
„ 29	5,062	176
July 6	5,107	710
„ 13	4,502	514
„ 20	4,215	220
„ 27	4,223	1,084
August 3	4,570	786
„ 10	5,048	2,110
„ 17	5,550	1,894
„ 24	5,372	1,540
„ 31	5,290	2,109
September 7	5,889	2,480
„ 14	6,856	1,976
„ 21	6,916	2,472
„ 28	5,964	1,908
October 5	5,956	1,794
„ 12	6,567	2,567
„ 19	6,676	2,789
„ 26	6,439	1,409
November 2	5,951	2,105
„ 9	7,332	2,245
„ 16	6,763	2,585
„ 23	6,084	2,315
„ 30	6,263	1,768
December 7	5,749	1,165
„ 14	6,554	764
„ 21	7,788	596
„ 28	1,756	284
Total for the Year	273,849	53,250

1856. Date.	Total Number of Beasts exposed for sale.	Number of Foreign Cattle included in first column.
January 4	4,092	355
„ 11	4,601	532
„ 18	4,800	563
„ 25	4,465	564
February 1	4,445	596
„ 8	4,978	685
„ 15	5,050	699
„ 22	4,974	629
„ 29	4,587	471
March 7	4,952	480
„ 14	4,631	208
„ 21	4,429	380
„ 28	3,810	250
April 4	5,212	311
„ 11	5,103	501
„ 18	4,215	61
„ 25	4,537	181
May 2	4,922	277
„ 9	5,283	74
„ 16	4,931	307
„ 23	4,886	682
„ 30	4,543	438
June 6	4,577	704
„ 13	4,128	520
„ 20	4,938	140
„ 27	4,314	189
July 4	4,271	574
„ 11	4,403	618
„ 18	4,208	150
„ 25	4,648	1,149
August 1	5,432	2,024
„ 8	5,785	1,789
„ 15	3,931	1,350
„ 22	4,523	1,533
„ 29	5,740	1,829
September 5	6,195	2,320
„ 12	5,949	1,949
„ 19	6,712	2,253
„ 26	6,775	2,432
October 3	6,955	2,593
„ 10	6,663	3,021
„ 17	6,534	2,706
„ 24	6,081	2,146
„ 31	6,519	2,193
November 7	6,695	1,946
„ 14	7,259	2,530
„ 21	5,904	1,500
„ 28	6,237	1,566
December 5	6,633	712
„ 12	6,072	540
„ 19	7,553	574
„ 26	2,343	419
Total for the Year	271,423	53,213

26th March 1857.

(Signed) WILLIAM SHANK,
Clerk, Metropolitan Cattle Market.

No. VIII.

AMOUNT of ARTICLES seized by INSPECTORS of SLAUGHTER HOUSES in the CITY of LONDON for the Years 1855–56, as returned to the Commissioners of Sewers of that City.

Articles seized.	1855.	1856.
Live Cow, diseased	1	—
Calves, carcases	45	32
Pigs „	64	64
Sheep „	507	321
Cows „	—	3
Beef, quarters	661	438
Mutton „	22	66
Lamb „	9	26
Veal „	4	39
Pork „	—	9
Joints, various	227	217
	stone lb.	*cwt. qrs.*
„ weighing	106 96	13 17
Sheep, live	25	—
Veal, sides	8	—
Tongues	3	5
Heads	15	10
Kidneys and Heart	3	—
Plucks	—	228
„	—	a lot
POULTRY, various heads	144	719
Deer	1	—
Fawns	8	6
Rabbits	431	1,197
Hares	90	52
Black Game	107	—
Ptarmigan	67	—
Fowls	17	—
Goats	—	2
Bucks	—	10
Ducks	21	—
Leverets	24	27
Puffins	75	—
„ 1 Basket	—	—
Venison, pieces	29	6
„ haunches	6	1
„ quarters	11	1
„ shoulders	9	2
Partridges	412	265
Pheasants	1	28
Grouse	392	52
Pigeons	120	14
Snipe	1	—
Turkey	1	—
Widgeons	—	18
Game	—	1 box
„ and Rabbits	—	1 hamper
„ and Larks	—	4 „
„ and Poultry	—	1 „
Gibiets	—	1 basket
Rabbits	—	2½ cases
„	—	2 hampers
FISH, Salmon	174	1
Cod	449	210
Trout	107	—
Whitings	150	—
Smelts	2,700	7,700
Plaice	12,103	6,778
Herrings	29,737	—
Sprats, Bushels	40	—
Turbots	26	17
Haddocks	2,256	868
Miscellaneous	30,557	9,895
Lobster	3,519	1,635
Crabs	2,387	1,375
Shrimps, Gallons	549	31
Soles, Pairs	341	460
Whelks, Bushels	16	5
Mussells „	32	10 bags
Periwinkles „	34	20
Brills	12	7
Eels	—	5 lbs.

The return of Fish seized in 1856 extends down to Midsummer only, no return having been received since that.

The Market for Live Cattle being removed away from the City, the Commissioners do not exercise any Jurisdiction therein.

We have no means of distinguishing in these returns the Articles seized as "diseased," as distinguished from those seized on account of decomposition.

(Signed) JOSEPH DAW,
Principal Clerk,
Sewers Office, Guildhall. 8th April 1857.

No. IX.

INSTRUCTIONS in respect to the DELIVERY of Cattle. Approved by the Commissioners of Her Majesty's Customs, on September 6th, 1856, and ordered to be delivered to the Officers in London, and transmitted to the Collectors and Comptrollers at the several out-ports.

The Commissioners of Customs deem it necessary, for the guidance of their Officers in all cases to which their General Order $\frac{74}{1856}$ applies, but with special reference to a contagious disease, called "Murrain," which has recently broken out amongst the horned cattle at Mecklenburg, to issue the following General Instructions, together with the accompanying statement of the symptoms of the particular disease in question.

1st. On the arrival of a vessel with cattle, sheep, lambs, or pigs, the attendance of the veterinary surgeon is to be obtained as soon as possible.

2nd. After the cattle, sheep, lambs, or pigs have been landed, they are to be kept in charge until each animal has undergone a careful examination, and if found free from disease the whole are to be passed immediately; but in the event of any disease being found to exist, such of them as may be so diseased are to be immediately killed, if the same be considered necessary by the veterinary surgeon; and if upon a post-mortem examination of such cattle, sheep, lambs, or pigs, the same be found fit for human consumption, they, and the rest of the importation, are to be delivered to the owner or owners thereof; but should any of those so examined be unfit for such purpose, and the disease be of an epidemic or contagious character, they are to be buried, or effectually destroyed, in the presence of an officer, and the remainder of the importation detained for further examination so long as the veterinary surgeon may deem necessary, and dealt with as before directed. The expenses incurred in detaining the whole or any part of the importation, or in killing and destroying those unfit for human food, to be defrayed by the owner or owners.

3rd. Sheep and lambs are not to be examined after dark, daylight being absolutely necessary for the detection of certain diseases.

Lastly. The veterinary surgeon is to be required to keep a record of the particulars of each transaction agreeably to the annexed form.

No. X.

A RETURN showing the NUMBER of ANIMALS imported from Foreign Ports which have been destroyed in consequence of being unfit for Human Food, through Disease, with the nature of the Complaint with which affected.

Date.	Port.	Number of Animals.	State and Condition of Animals.
Between 1st January and 6th March 1857.	London	One Cow -	Labouring under Pleuro-pneumonia. Sent to the knackers and destroyed.
"	London	One Ox -	Labouring under inflammatory fever. Sent to the knackers and destroyed.
"	London	One Calf -	Labouring under fœtid fever of an infectious character. Sent to the knackers and destroyed.
Between 7th and 8th March.	London	Two Cows	Labouring under inflammatory fever. Sent to the knackers and destroyed.
17th March	London	Two Oxen	Labouring under Pleuro-pneumonia. Sent to the knackers and destroyed.

LONDON:
Printed by George E. Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

REPORT

ON

THE MEANS

OF

DEODORIZING AND UTILIZING

THE

SEWAGE OF TOWNS;

ADDRESSED TO THE

RT. HON. THE PRESIDENT OF THE GENERAL BOARD OF HEALTH,

BY

HENRY AUSTIN, C.E.,

CHIEF SUPERINTENDING INSPECTOR OF THE BOARD.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:

PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,

PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

FOR HER MAJESTY'S STATIONERY OFFICE.

1857.

2262

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REPORT

ON THE

MEANS OF DEODORIZING AND UTILIZING THE SEWAGE OF TOWNS.

To the Right Hon. William Monsell, M.P.,
President of the General Board of Health.

Sir,

During the past eight years, in which the sanitary improvement of populous towns has occupied the attention of Local Boards of Health, acting in execution of the Public Health Act, 1848, consideration has been almost exclusively directed to two great evils which pressed peculiarly for immediate remedy, —imperfect drainage, and the want of water.

The earliest inquiries into the causes of the great mortality of urban populations had established the fact that collections of decaying matter, within towns, were among the chief sources of disease, and that among these accumulations the contents of the cesspool were the most dangerous.

It is not surprising, therefore, that the first endeavours of local authorities should have been for the removal of this chief cause of disease from amidst habitations.

In many towns this work has been thoroughly accomplished, and there for the most part the authorities have rested, as if all sanitary improvement began and ended with it. But Nature's laws allow of no such halting. The mere removal of the decomposing mass is but a shifting of the mischief. The great cycle of life, decay, and reproduction must be completed, and so long as the elements of reproduction are not employed for good, they will work for evil.

It would argue very little acquaintance with the principles of sanitary laws, if local authorities really

considered their duties complete at this point of their labours. The disposal of town refuse for the purpose of fertilization, has been so often urged that even these few remarks on the subject may seem superfluous. Reasons must be sought for the apparent apathy which has hitherto reigned on this point. Ignorance cannot be pleaded. Obviously the doubts and difficulties which have hitherto surrounded the question have stayed its practical solution.

The evil, however, of the present mode of dealing with the question—or rather of not dealing with it, by allowing the refuse of towns to poison the neighbouring streams is great beyond anticipation. Most of the refuse of houses having been hitherto chiefly stored in cesspools, the state of drainage-outfalls, nuisance as they were, served only to mislead the judgment as to the probable effect of complete drainage.

It is, perhaps, fortunate that the magnitude of the evil must lead to its cure. Independently of the detriment to life and the waste which result from the present state of things, the law courts have decided that local authorities have not the power to increase the pollution of streams, to the injury of individual rights,—to rid themselves of a nuisance by sending it on to their neighbours. Thus, the outfall of drainage becomes at this time the great and pressing difficulty of the sanitary question; and that difficulty appears to arise mainly from the fact that the sanitary and agricultural aspects of the matter are somewhat at issue.

On sanitary grounds, it has been determined that water supplied the best means for carrying off the great body of noxious refuse from the site of towns. But this very mode of removal deteriorates the value of the material as a manure; so that some persons, who ignore all the sanitary bearings of the question, are of opinion that the actual system of town drainage is wrong in principle; that the cesspool and separate collection of the manure should have been adhered to.

How far this view is correct, even upon economical grounds, it is not for me now to consider. The sanitary question is paramount; and the means of the

removal of the refuse are, in this report, regarded as fixed.

The point, as I conceive, to be determined is the best practicable mode of rendering outfalls of drainage innocuous, and of realizing from sewage, diluted as it is, the highest possible value.

No practical difficulty stands in the way of complete removal of all nuisance at outfalls, except the expense. Well-known disinfectants could be successfully employed for removing, at any rate to a great extent, the noxious properties of sewage.

Some of these disinfectants, although efficacious as sanitary agents, destroy or impair the value of the sewage as manure, and their use would add largely to the already heavy expences of drainage.

Were this sacrifice necessary for the preservation of the public health, the prudent course, even on the ground of economy, would be to submit to it; but other ingredients, equally effective as disinfectants, are found not to interfere with the value of the sewage for manure.

The problem for solution is, while accomplishing the sanitary object, how best to realize the agricultural.

Water is the vehicle in which the fœcal refuse of towns is now conveyed away. If the same means of conveyance could be conveniently and beneficially used at all times, and under all circumstances, to carry the manure on to the land where required, or if, after bringing the manure to the outfall, the water could be got rid of and the excrementitious matters separated, with all their original constituents, there would be no longer any difficulty in the question; sewage would have its fixed and decided value wherever manure is wanted, which would go far to relieve the inhabitants of town districts from all the expense of sanitary improvement.

But neither of these methods of realizing the value of sewage is at all times practicable. The practicability of application by water depends on the levels and character of the surrounding country, the seasons, the nature of the soil, the water supply, the rainfall, the crops, the proportion of land available for liquid sewage, and the various interests in the property. The separation of the sewage from the

water, is involved in still greater difficulty. The solid may be precipitated, but the valuable ingredients of the sewage are held in solution in the water, and no chemical process—it is said by those authorities who have given the greatest unbiassed attention to the subject—has yet been made available for their separation.

It remains to be considered what proportion of the total value it may be practicable, under ordinary conditions, to realize by either of these methods of use, or by a union of the two.

Much attention has now been given to both these divisions of the question for some years. But the subject is still too recent to admit of fixed rules being laid down. Means, however, exist for correcting both the views of the over sanguine and zealous, and those of the incredulous and the prejudiced. Having had the honour to receive the instructions of the late President to make such inquiries and collect such evidence as may serve for the guidance of Local Boards under the difficulty which so urgently presses upon them, I now congratulate myself that the duties which devolved upon me, when acting as Secretary to the first General Board of Health, prevented my taking part in the inquiries into this subject which were then conducted, as this enables me to bring an unbiassed mind to the consideration of the subject.

I have necessarily travelled over some of the same ground as previous inquirers; and where I have not been able to arrive at the same conclusions, I trust that the reasons for the disagreement will be found sufficiently explicit.

In setting forth the result of my inquiries, both chemical and agricultural questions are necessarily brought under consideration; but I wish to guard against any impression that I give any opinion of my own on either class of questions. Wherever they are involved, I have endeavoured to satisfy myself, and support my conclusions, by reference to the highest authorities.

With these preliminary remarks, I beg to lay before you the following Report, merely adding that it should be read as having especial reference to the smaller

class of towns. The principles of action being admitted, it becomes an important question in what way they can be made applicable to places of the largest population. The difficulty will be in bringing them practically to bear in towns which can afford but little outlay, and to such towns, therefore, the remarks and suggestions which I have to offer are chiefly directed.

To facilitate reference, I have divided my Report under the following heads :—

1st. The constituents of sewage and their value, as far as the hitherto inadequate examinations and analyses will allow of any safe calculation of value ;

2nd. A description of the chief processes which have been adopted for deodorizing sewage, and for manufacturing therefrom a solid manure ;

3rd. A description of the means hitherto practised for the application of sewage to agriculture in the liquid form;

4th. The agricultural results of these various processes ;

and I have ventured to add recommendations of the means which appeared to me, in the present state of the question, best calculated to realize the value of sewage, while securing the removal of all danger to the Public Health.

Constituents of Sewage.

The sewage of towns consists of the solid and liquid excrements of the population, the ingredients of soap, the refuse from kitchens, the drainings and washings from markets, stables, cow-houses, pigstyes, slaughter-houses, &c., the refuse drainage from many factories and trading establishments, the washings of streets and other open surfaces.

It would be difficult at present to obtain precise data for determining the value of the sewage of towns. This is a point which demands much more searching investigation than has hitherto been given to it. A long series of examinations would be necessary to arrive at an average in any one town. The quality must be tested at various times of the day, for the drainage of house refuse is much greater at one

period than another, and the discharge from factories frequently takes place at particular hours. Different days again will show great variation. The house drainage will be greatest on Saturday, least on Sunday, and market day in many places will add perceptibly to the discharge at the outfall. Again, the rainfall would demand separate consideration. A moderate fall of rain after dry weather may actually increase the usual proportion of manuring ingredients, by washing down deposited matters, while a heavy discharge may so add to the dilution of the sewage after the first flush as to render the whole worth little.

Moreover, no such series of observations for any one town would form a safe general guide. Material differences would be found in towns having respectively a larger proportion of old or of new drainage works. In many of the former, much of the solid matter is deposited along the course of the drains, and the flow being sluggish, decomposition is far advanced, and gases are discharged, before the outfall is reached. In many of the latter the discharge is found to be so immediate that solid excrement is not even disintegrated.

In towns of rich and of poor population the quality of the sewage may also materially differ. Speaking of the excess of animal food consumed by the classes in easy circumstances, Professor Way says, "the nitrogen of this food is discharged in the fæces, which are probably therefore much richer in this element than that of the working community." A speculation has been cited in which a favourable result was obtained from the manufacture of manure from the refuse of a rich establishment, which failed with that of a poor one. The value of the refuse of Belgravia would, no doubt, exceed that of Bethnal Green.

The sewage of a manufacturing town would vary much also from one with a non-manufacturing population. The sewage of Manchester and Bradford would scarcely be identical in its constituents with that of Brighton and Bath.

Even times of commercial prosperity and depression must, in many towns, cause a material change in the nature of the sewage. In the manufacturing towns of Lancashire,—indeed in all towns dependent

chiefly on their factories,—both the quantities and quality of the discharges must vary to a great extent in proportion to the manufacturing activity of a period.

Again, and especially, the difference of water supply, both in quantity and quality, the amount of rain-fall, the comparative completeness of drainage arrangements, and the proportion of subsoil water carried off by the sewers, would seriously affect conclusions on this point.

The value of the sewage of a town can only be determined from a series of analyses of that sewage.

Except in one particular, no general calculation can be made of the amount and value of the various refuse ingredients discharged. The exception is the solid and liquid excrements of an average of the population, which, doubtless, constitutes the most valuable portion of the sewage.

Considerable attention has for a long time been given by physiologists to the determination of the chemical constituents of human excrement, and renewed researches have more recently been made by chemists with especial reference to the utilization of sewage.

Professor Voœlcker states, in Morton's Cyclopædia of Agriculture, that the three classes of constituents on which the commercial as well as the fertilizing nature of all manuring matters chiefly depends, are, 1st, ammonia, and organic matters furnishing ammonia on decomposition; 2nd, soluble alkaline salts; 3rd, phosphates. And that "of all the natural manures obtained in this country, human excrements contain a much larger proportion of ammonia, or organic matters which furnish this valuable compound on decomposition,—more alkaline salts, especially salts of potash,—and a larger proportion of phosphoric acid, than either the excrements of the horse, cow, sheep, or pig."

Mr. Bennett Lawes, in the valuable paper read before the Society of Arts in 1855, gives an elaborate series of Tables, embodying the conclusions arrived at by various authorities from analyses of the food consumed by various classes at different ages, from direct experiments on human respiration, and from analyses of excrement. The general result deduced from these extended inquiries, is that the total dry substance of

the excrements voided each day amount for the average of both sexes at all ages to 2·01 ounces, or 965 grains per head per day, or nearly 46 lbs. per annum.

There appears to be no question that of the various constituents comprised in this amount the nitrogen is the most valuable, and of the total dry solid per day ·35 of an ounce or 168 grains are nitrogen, being equal to 17·4 per cent. of the whole.

Professor Way gives the result of two examinations on the subject, in an important article on the "Use of Town Sewage as Manure," in the Journal of 1854, of the Royal Agricultural Society of England, in which the average total dry substance is estimated at 1,057 grains, and of this quantity 141·25 grains, or 13·3 per cent., are nitrogen.

Dr. Angus Smith, in a Table furnished to the first General Board of Health, gives 8,269 lbs. as the annual weight of the excretions of 100 adults, of which 2,312 lbs. are nitrogen. These quantities give 1,585 grains as the total dry substance per head per day, of which 443 grains, or 27·9 per cent. are nitrogen.

The nitrogen in this calculation is considerably in excess of the two cases previously cited; but the total solid is not so much so as at first sight appears, for on referring to the details of Mr. Lawes' table, the dry substance and the nitrogen of the excrements of children, so far as they were examined, are seen to be little more than half that of adults. And the average of dry substance from adults is 2·635 ounces, or 1,265 grains per day.

The actual value of the chemical constituents of the dry substance of the excrement of each individual, amounting to 46 lbs. per annum, Mr. Lawes estimates at 6*s*.

Beyond this, there appears to be no trustworthiness in any calculation made up to this time of the value of sewage. So far indeed as the examination of the sewage itself of different places has extended, an attempt to arrive at any conclusion seems to be followed only by contradiction and uncertainty.

The Rugby sewage in dry weather is now said to amount daily to 160,000 gallons, from a population of 7,000, or 23 gallons per head. Cesspools being now entirely abolished, the solid substance of the fæcal

matter alone of the population conveyed in this quantity of water would amount to 1 in 1,669, and would contain, according to the above calculation, 7·3 grains of nitrogen per gallon. In an early sample, however, examined by Professor Way, only 2·96 grains of ammonia were found. In a sample from another completely drained town, Croydon, only 0·92 grains of ammonia per gallon were found. In this latter case, an immense waste of water and a large body of subsoil water were originally drained to the outfall, and in both cases the quantity of suspended matter was said to be insufficient for examination.

The only criterion of value which has yet, for the most part, been determined is the amount of solid matter in suspension and solution in the sewage,—of itself a most uncertain guide to its value.

Mr. Walker, who leases the sewage of Rugby, calculates that he obtains 1 ton of solid matter in 50,000 gallons, being at the rate of 1 in 223! This quantity, however, was determined by one trial only, on a small scale, by precipitation with lime, in which there would clearly be a large element of error.

A sample of the Leicester sewage (a town in which cesspools have as yet been scarcely interfered with), taken during continuous rain, gave a proportion of 1 of solid in 700 of liquid; and another sample from the imperfectly drained town of Cheltenham gave 1 in 729. These examinations were made by Mr. Lindsey Blyth. The amount of solid matter contained in the sewage of Tottenham, a completely drained district, was not determined, but the proportion in which it exceeded the above in the chief elements of value may be approximated to by the following Table, furnished by Mr. Blyth, of the relative ingredients of the dried deposit of each:—

Dried Deposit from the Sewage of	Organic Matter.		Mineral Constituents.	
	Total per-centage.	Containing Nitrogen.	Total per-centage.	Containing Phosphates.
Leicester - -	31·40	0·98	68·60	8·56
Cheltenham - -	27·61	0·91	72·39	10·28
Tottenham - -	33·86	1·52	66·14	12·66

Samples of the sewage of Ottery St. Mary and of St. Thomas's, near Exeter, were examined by Mr. Herapath. The former was taken during rain, and was found to contain only 55¼ grains in the gallon, or 1 in 1,267, only "one-sixth the strength, remarked Mr. Herapath, "of the average ordinary fluid." The sample from St. Thomas's contained 2½ cwt. in 14,333 gallons, or 1 in 512.

The ordinary flow of the refuse from the Puddle Dock sewer in the city of London, where Mr. Higgs's works were first established, was said to contain a proportion of solid of 1 in 400.

That the quantity of ammonia found in the samples from Rugby and Croydon, above referred to, does not represent the amount of fertilizing elements that may be usually expected in the sewage of *completely* drained towns, more detailed analyses of samples of sewage from *imperfectly* drained places will show.

Professor Way made complete analyses of samples from two different parts of the metropolis, one Barrett's-court, representing the more densely peopled districts; the other Dorset-square, the more open districts. The results are embodied in the valuable paper in the Journal of the Royal Agricultural Society of England, before referred to. In the Barrett-court sample 492·26 grains of solid matter were found in the imperial gallon, or 1 in 142. In the Dorset-square sample, 209·70 grains were found, or 1 in 334.

Of ammonia in a gallon, these samples contained—

——	Barrett's-court.	Dorset-square.
In the soluble state - - -	36·72 grs.	15·16 grs.
In the insoluble state - -	4·56 „	2·80 „

"It will be observed that the water from Dorset-square contains less than one half the quantity of soluble and insoluble matters found in the other specimen, and the quantities of ammonia and phosphoric acid are in the same proportion."

The following are the analyses:—

No. 1.—From Barrett's-court.

	An imperial gallon contains (in grains and tenths)—		
	Soluble.	Insoluble.	Both.
Organic matter, and salts of ammonia	121·50	180·32	301·82
Sand and detritus of the granite from the streets.	*1·39	19·30	20·69
Soluble silica	1·57	10·94	12·51
Phosphoric acid	7·71	2·73	10·44
Sulphuric acid	10·71	4·02	14·73
Carbonic acid	11·62	3·97	15·59
Lime	7·50	17·03	24·53
Magnesia	2·87	Traces.	2·87
Peroxide of iron and alumina	Traces.	6·20	6·20
Potash	46·91	1·22	48·13
Soda	—	1·51	1·51
Chloride of potassium	—	—	—
Chloride of sodium	31·52	1·72	33·24
	243·30	248·96	492·26

No. 2.—From Dorset-square.

	An imperial gallon contains (in grains and tenths)—		
	Soluble.	Insoluble.	Both.
Organic matter and salts of ammonia	57·32	23·00	80·32
Sand and detritus of the granite from the streets	0·78	44·50	45·28
Soluble silica	1·16	12·09	13·25
Phosphoric acid	2·53	1·64	4·17
Sulphuric acid	0·28	3·63	3·91
Carbonic acid	10·58	1·99	12·57
Lime	7·40	8·37	15·77
Magnesia	0·07	Trace.	·07
Peroxide of iron and alumina	Trace.	2·66	2·66
Potash	2·60	0·72	3·32
Soda	—	—	—
Chloride of potassium	—	—	—
Chloride of sodium	27·27	2·10	29·37
	109·00	100·70	209·70

* "This is some small proportion of insoluble matter escaping the linen filter, and properly belonging to the other column."

The examinations, under the direction of Dr. Anderson, of the Edinburgh sewage and of a sample from the tank of the Morningside Lunatic Asylum, bear the same conclusion. The proportion of solid found in the sample from the Lochend sewer, Edinburgh, was 1 in 665 ; that from the Morningside sewer contained 1 in 527.

The following analyses of these samples are from the Journal of the Agricultural Society of Scotland :—

Sample from Lochend sewer.

	Grains per gallon.
Organic matter soluble in water -	21·90
Organic matter insoluble in water	21·70
Peroxide of iron and alumina -	2·01
Lime - - - -	10·50
Magnesia - - -	2·00
Sulphuric acid - - -	6·09
Phosphoric acid - - -	6·14
Chlorine - - -	12·20
Potash - - - -	2·89
Soda - - - -	13·27
Silica - - - -	6·50
	105·20

Dr. Anderson states, " What is here called organic matter is the whole amount of volatile matter expelled by a red heat. It contains, however, a very large quantity of ammonia, amounting to not less than 7·7 grains in the gallon; in addition to which the organic matter contained 5·93 grains of nitrogen in the form of nitrogenous compounds, so that altogether the quantity of nitrogen present must be considered remarkably large."

In the tank from which the Morningside sample was taken, the whole sewage from the lunatic asylum was collected. The following is the analysis :—

	Grains per gallon.
Organic matter - - -	51·77
Alumina - - -	4·93
Protoxide of iron - -	10·34
Lime - - - -	11·99
Magnesia - - -	2·85
Chloride of sodium - -	4·49
Soda - - - -	3·00
Potash - - - -	2·66
Carbonic acid - - -	11·22
Sulphuric acid - - -	3·12
Phosphoric acid - - -	1·32
Silica - - - -	25·02
	132·71
Ammonia - - -	3·18

It will be observed that this sample does not contain one-fourth of the nitrogen of that from the Lochend sewer, although it contains a much larger amount of solid matter. With reference to this point, however, I find that whereas this sample from the Lochend sewer was found to contain 1 of solid in 665 of liquid, a sample from the same sewer, examined by the late Mr. Phillips, of the Museum of Economic Geology, contained the large proportion of 1 in 214.

Dr. Anderson considers that so large a quantity of nitrogen as was found in the Edinburgh sample of sewage, examined under his directions, would not be found at all times, and that the Morningside sample, in all probability, gives a *better general idea* of the value of sewage; and yet the Edinburgh sample contained but little more than a third of what was found in the specimen from Barrett's-court.

I have put together the above cases, and have quoted these examinations rather with the idea of showing how inadequate are the present means for arriving at any general conclusion of the actual value of sewage waters as manure, than of presenting any precise data for the calculation. Many other

analyses, no doubt, exist, which have not fallen in my way; but looking at the varying nature of the subject, I do not apprehend that they would serve for guidance any more than the above examinations.

The only conclusions deducible from the scattered investigations hitherto conducted are, that there does exist in the ordinary sewage water, from the houses of a town, a large body of solid matter in suspension and solution, to the extent at least of two or three times what is due solely to the fæcal refuse of the population;—that this additional matter varies much in different places;—that though it bears a certain value in all, this is not for the most part a great value, and that in the present state of knowledge upon the subject it would not be safe to attempt any general calculation of that value.

The amount and value of refuse carried to the sewers from open surfaces of a town by rain, is a branch of the inquiry which has received still less attention, and which, equally varying with the different characters of towns, demands extended investigation.

The only examinations of this kind with which I am acquainted are those conducted by Professor Way, with such remarkable results. The following particulars are extracted from his paper:—

His examinations were made on "ten samples of rainwater which, having fallen in the streets, had been intercepted in their passage to the sewers. They were collected from streets of different kinds, some being paved with granite, and others macadamized. In some cases also the traffic in the streets was considerable, in others very limited.

"All these circumstances had, as the analyses show, a perceptible influence on the quality of the waters. The mechanically abraded matters of the street were collected as well as the waters themselves.

"The following Table shows the quantity of matter, both in solution and in the solid state, in an imperial gallon of the different samples:—

STREET WATER.

Number of Bottle.	Name of Street.	Quality of Paving.	Quality of Traffic.	Residue in an Imperial Gallon.		
				Soluble.	Insoluble.	Both.
				Grains.	Grains.	Grains.
1	Duke-street, Manchester-square -	Macadamized -	Middling -	92·80	105·95	198·75
7	Foley-street (upper part) - -	do. - -	Little - -	95·30	116·30	211·43
5	Gower-street - - - -	Granite -	Middling -	126·00	168·30	294·30
12	Norton-street - - - -	do. - -	Little - -	123·87	3·00	126·87
3	Hampstead-road (above the Canal) -	Ballasted -	Great - -	96·00	84·00	180·00
4	Ferdinand-street - - -	do. - -	Middling -	44·00	48·30	92·30
2	Ferdinand-place - - -	do. - -	Little - -	50·80	34·30	85·10
10	Oxford-street - - - -	Granite -	Great - -	276·23	537·10	813·33
6	Do. - - - -	Macadamized -	do. - -	194·62	390·30	584·92
11	Do. - - - -	Wood - -	do. - -	34·00	5·00	39·00

"Four samples of these waters were further analysed, and the results are very interesting.

"Two samples were from granite, and the other two from macadamized roads.

"ANALYSIS of the SOLUBLE MATTER in DIFFERENT SPECIMENS of STREET DRAINAGE WATER."

	Grains in an Imperial Gallon.			
	Great Traffic.		Little Traffic.	
	Granite. No. 10.	Macadam. No. 6.	Granite. No. 12.	Macadam. No. 7.
Water of combination and some soluble organic matter.	77·56	29·07	22·72	13·73
Silica	0·51	2·81	—	—
Carbonic acid	15·84	12·23	None.	None.
Sulphuric acid	36·49	38·23	46·48	34·08
Lime	6·65	13·38	25·90	16·10
Magnesia	None.	23·51	Trace.	3·50
Oxide of iron and alumina, with a little phosphate of lime	2·58	1·25	—	—
Chloride of potassium.	None.	10·99	None.	2·79
„ sodium	53·84	44·88	18·44	19·70
Potash	82·76	18·27	8·75	5·23
Soda	—	—	1·58	—
	276·23	194·62	123·87	95·13

I instance these cases to show that this part of the subject is most worthy of attention also. Professor Way adds, that "so far as London is concerned, and considering only the composition of the liquid which reaches the sewers in the time of rain from the streets, it seems pretty certain that it would be as valuable in a manuring point of view as the ordinary contents of the sewers. There would seem no reason, therefore, to exclude such waters on the ground of the dilution and deterioration of the sewage to which they might be supposed to lead." It is clear, however, that nothing like these results are to be expected under usual circumstances. And such liquids are still less capable of any general estimate than the miscellaneous matters of house sewage; but I shall have to return to the subject of the separation of drainage upon other considerations.

Such being the uncertain position of the question, I refrain from attaching any positive value to these adidtions to the sewage, either from ordinary household operations or from the washings of external sur-

faces. I am content for the present purpose to admit that the *minimum* value of sewage is comprised in the excrementitious refuse of the population, and is represented by six shillings per head per annum.

This looks a small sum in itself; let us see what it means in reality. It means 3,000*l.* per annum for every 10,000 of the population. *It means an average annual rate of upwards of eighteen pence in the pound!** And the difference between this sum and the actual cost of getting this manure on the land means the amount of the *direct* money loss from permitting this matter to pollute our rivers and injure our health.

I shall endeavour to arrive at a reliable calculation of the cost of its more profitable employment for agricultural purposes.

The Deodorization of Sewage and its Manufacture into Solid Manure.

The chief plans for treating the sewage of towns, and applying it to the fertilization of land, may be designated the solid and the liquid methods.

I shall proceed, in the first place, with a description of the solid methods, which aim at obtaining from the sewage a dry, portable manure. These may be subdivided into three classes of operations:—

1st. The precipitation of the solid matters held in mechanical suspension and partial solution in the water, by the addition to the sewage of various chemical ingredients.

2nd. The separation of the solid matters in suspension by straining or filtration, and their admixture with various solid deodorizing materials.

3rd. Simple deposition and draining off of the liquid from the solid mass.

1. *Chemical Processes for separating the Solid Matter of Sewage.*

Judging from the number of patents which have been granted for the chemical treatment of night-soil and

* The total of the rateable value of property assessed to the poor's rate in England and Wales, contained in the return of 1854 relating to poor law unions, amounts to 67,730,299*l.*; the total of the population included in the same return being 17,718,605.

other town refuse for the manufacture of solid manure, the subject appears to have engaged considerable attention for the last twenty years. Indeed, the first patent was granted in 1802, to Lewis James Armand Estienne, for converting "human excrement into a powder divested of all smell, preserving at the same time its fertilizing properties;" but no other patent for similar purposes seems to have been obtained until 1835.

From that period to the end of last year, patents were granted for dealing in some way with town refuse, the first patent for treating sewage matter at the outfalls of drainage being that of Mr. Higgs, in 1846.

The majority of these patents appear never to have come into operation, and I do not propose, therefore, to enter into any general description of them; but, as it may probably possess some interest, I have added a list of them in the Appendix (A.). I shall submit only here a brief account of those operations which have chiefly commanded public attention, and of those which I have had an opportunity of examining.

The principal process hitherto adopted for the preparation of a solid sewage manure consists of the admixture of a certain proportion of lime, of the consistency of cream, with the sewage as it flows to the outfall, whereby the solid matters in suspension are rapidly precipitated, and some of those in solution disengaged, and the supernatant water allowed to flow off in a comparatively pure state.

The lime process is chiefly represented by the patents of Mr. Higgs and Mr. Wicksteed. In 1849 works were established at the outfall of one of the main sewers in the City of London, for the purpose of carrying out Mr. Higgs' patent process. These not having proved commercially successful, were subsequently abandoned, but works have since been established on Mr. Higgs' plan at Cardiff gaol, and recently on a more extended and perfect scale at Tottenham.

This town, which now comprises about 10,000 inhabitants, has been completely drained under the

Public Health Act. The outfall was led into the nearest stream, where of course the pollution from refuse, before retained amidst the habitations of the people, soon became a considerable, although less dangerous nuisance. It was the subject of great complaint, and the next step was to seek for some means of avoiding the evil consequences of this noxious discharge.

Sewage works have been erected by a company at great expense for carrying out the lime process under Mr. Higgs' superintendence.

These works comprise a reservoir capable of holding 44,000 gallons, into which the sewage is first received, and then raised consecutively into 4 iron tanks (each capable of holding 5,000 gallons) by an engine of 10-inch cylinder, 16-inch stroke, working up to 8-horse power. The engine in ordinary work makes 110 strokes per minute, and the pumps 900 strokes per minute.

Cream of lime is poured into and mixed with the sewage as it passes into the iron tanks. The proportion of lime used is estimated to be one fourth of the solid matter of the sewage and the solid of the sewage is calculated by Mr. Higgs to be on the average 1 in 500 of the liquid.

Only $1\frac{1}{2}$ per cent. of this solid matter at Tottenham is stated to be grit.

When each tank is charged, from half an hour to an hour is allowed for settlement before the liquid is passed off to the outfall, and 7 or 8 deposits are made before the solid is removed.

The great difficulty which has been experienced in the lime process both here and at Leicester has been the drying of the sewage, so as to render it portable.

Various expedients have been tried at both places, and successively abandoned. At Tottenham a quantity of the manure had been dried by various means, but the difficulty of accomplishing this economically had not been overcome at the time of my visit. The new plan then proposed, but not in operation, was to pass the sewage, in the semi-fluid state in which it is withdrawn from the tanks, round a drum in a thin

layer, from which it would continuously fall on to a series of heated plates.

A great discharge of foul gases takes place on disturbance of the deposit in the tanks. At Tottenham these gases are not allowed to escape, but are conducted to a purifying air chamber, and there treated with hydrochloric acid and oxide of manganese. The whole establishment was perfectly free from noxious or unpleasant odour.

The price of the manure was fixed at 4*l.* per ton.

A circumstance remarked at Tottenham is so illustrative of the rapidity with which, in a properly graduated system of drainage with a smooth channel, the refuse flows from the houses to the outfall, before decomposition or disintegration of the solids has to any extent taken place, that it is worth recording. A small recess or pit is formed at the mouth of the sewer, guarded by a wire screen, for the purpose of intercepting any foreign substances that might otherwise reach the pumps, and it is the duty of a boy to attend at this pit to clear away rags, paper, &c., that would otherwise choke the screen. A sufficient quantity of soap in cake or lump is daily found here to pay for this labour.

The largest works, however, for carrying out the lime process have been established by a company at Leicester under Mr. Wicksteed's patents. The principle is precisely the same as that adopted at the works just described. It differs only in the modes of operation, and in the adoption of various improvements which experience has from time to time pointed out.

Leicester contains about 65,000 inhabitants. The Local Board being compelled by their Act of Parliament to raise and deodorize the whole of the sewage of the town, in order to prevent pollution of the river, entered into an agreement with the Solid Sewage Manure Company, whereby a lease of the sewage was granted by the Local Board, on the condition that the Company should erect works for the continuous pumping of the sewage, and for its complete deodori-

zation, at their own cost. A complete system of public sewers has been constructed in the town, and a large number of manufactories are drained into them; but a considerable proportion of the houses has not yet been properly drained. Cesspools still prevail in the town for the most part. The outfall, where the sewage works are established, is about a mile below the town, and here the whole liquid drainage, except in times of flood, is dealt with by the lime process.

The sewage flows into a pump well, whence duplicate engines, with 25-inch cylinders, 7 feet 6 inches stroke, and 28-inch pumps, raise it to the level of the reservoirs.

Quicklime, mixed in water to the consistency of cream, is raised at the same time by the same engine, and discharged in certain proportions, varying from 2 to 16 grains per gallon, into the pipe which conveys the sewage. The two are intimately mixed by a series of agitators, and afterwards pass through a perforated chamber into the first reservoir, where the greater part of the solid matter is precipitated.

The bottom of this reservoir is sloped from 5 feet depth at the sides to 15 feet in the middle to a centre channel or trench, along which an Archimedean screw of 3 feet in diameter continuously works, drawing the precipitated matter into a covered well at the upper end. From this it is lifted by a Jacob's ladder of dredging buckets alternately to one of two tanks twenty feet above on an upper floor.

At this stage of the process the material raised from the reservoir is in a state of "slush," and the chief difficulty until recently appears to have been, as stated with regard to the works at Tottenham, to get rid of the remaining fluid. At Leicester this difficulty has now been ingeniously overcome by Mr. Wicksteed, by means much more perfect and far less costly than those hitherto employed.

A portion of the semi-fluid sewage in the tank descends through a pipe into a portable apparatus below, consisting of a pile of filtering trays secured together, from which the water is discharged by the pressure of the remaining sewage above. The solid matter comes from the trays of this press in firm slabs, and

it is then cut by strings into ordinary sized bricks, and put out to dry.

The agitators, screw, and Jacob's ladder are worked by a separate engine.

The first reservoir is about 60 feet in length and 45 feet wide, and the liquid sewage travels from it, at the rate of about a quarter of an inch per second, to a second reservoir, 130 feet long, where further settlement takes place; seven-eighths, however, of the precipitation take place in the first reservoir.

An offensive odour pervaded the buildings at the time of my visit, which evidently escaped from the sewage deposit as it was raised from the bottom of the reservoir. On opening the chamber in which the Jacob's ladder works the effluvium was intolerable, but this might be very readily dealt with, and all nuisance obviated.

The water which flowed off to the river after treatment with the lime possessed still a perceptible smell and taste, although the sewage was in a very diluted state on that day from continuous rain; but as proof of the great improvement which these works have occasioned in the condition of the river, it must be stated that fish have recently returned to old haunts at a short distance below, where they have not been seen for many years.

It is said that upwards of 30,000*l.* have been expended upon these works. This amount, however, must not be taken as the necessary cost of establishing similar works elsewhere, a considerable sum having, no doubt, been sunk in the various trials and experiments necessary to bring the process to its present practical condition. Mr. Wicksteed calculates that works sufficient for a population of 500,000 could be established for the sum of 40,000*l.*

From this population it is estimated that 60,000 tons of manure would be produced per annum prepared in a plastic state, like clay ready for brick-making, at a cost of 2*s.* 4*d.* per ton, including the discharge into carts or barges lying alongside the works.

The price of the dried manure of the Company was a few months ago fixed at 40*s.* per ton. There

having been little or no demand for it, and a large and increasing accumulation at the Company's works, it has been more recently offered at 25*s.* per ton.

While treating of the lime process, I must not omit mention of the important trials recently carried out by Dr. Angus Smith, Mr. Crace Calvert and Mr. McDougall, on the foul water of the River Medlock at Manchester.

In the account of these experiments published by the Manchester and Salford Sanitary Association, the effect of the admixture of lime with the river water is thus described:—"When lime is thrown into the River Medlock it produces what may be familiarly called 'curdling,' which results from the formation of a very flocculent precipitate. This precipitate is formed by the combination of the lime with the carbonic acid, organic matter, and other substances held in solution and suspension in the water. It separates into large and distinct portions, which subside very rapidly. Careful observations repeatedly made show that the precipitate falls at the rate of about 1 foot in 8 minutes, or about $1\frac{1}{2}$ inches per minute."

It was found that about 2 grains of lime per gallon added to the water of the Medlock which had the most repulsive odour almost totally deprived it of unpleasant smell.

This proportion of lime appears to have been confirmed also as sufficient on a large scale, if time enough could be given for the operation of the lime before the precipitate was allowed to take place.

In the early experiments it was found that 17 cwt. of lime mixed with 1,000,000 gallons of water produced instant precipitation without excess or causticity. "The precipitate so made contained no caustic lime: the water also ran free from caustic lime." Further trials, however, determined that under more favourable circumstances 10 cwt. of lime would be sufficient for immediate precipitation from 800,000 to 1,000,000 gallons of water.

Considering it an important thing to devise some means of reducing still further the quantity of lime,

it was tried whether the lime which had once been used had really done all the duty that it was capable of performing. It was found by using the precipitated matter over again to repeated fresh charges of the same quantity of impure water, a fourth charge was acted upon with nearly equal advantage. So that where a large subsiding area could be obtained, and the water could be kept sufficiently long in suspension, it was concluded that somewhat more than a fourth of the above quantity of lime, or about 3 cwt. per million gallons, would effect the complete precipitation.

Mr. Calvert states that "to appreciate fully the value of lime, it is necessary to draw attention to the following important fact, namely, that if we take the average amount of organic matter in suspension and solution as 12·11 grains per gallon, there remains after treatment by lime only 3·5 grains per gallon *in solution*, or, in fact, a quantity less than exists in many river waters which are used for domestic purposes."

The full effect of the application of lime, as regards the smell of the water, was not sufficiently ascertained, owing to the imperfection of the apparatus and arrangements.

On this subject Dr. Smith and Mr. McDougall remark:—"We found the smell of the water of the Medlock was not entirely removed by precipitation with lime, or if removed, that it soon returned; we therefore used a disinfecting agent to the amount of 2¼ per cent. of the lime used. We used for this purpose our own powder."

As to the value of the precipitate, Dr. Smith and Mr. McDougall state that it "has a certain value as a manure, although not a great one. It may be advantageously used near the banks of the canal, but at the distance of even a few miles, it could not be used economically by farmers, as it would not bear the cost of transport."

"At any rate, the value of our precipitate cannot be reckoned higher than 7*s.* 6*d.* per ton." And Mr. Calvert also remarks "*that no great commercial value* can be attributed to this deposit."

With reference to the proportion of lime, namely, 3 cwt. per million gallons, which was found to be sufficient for deodorizing the waters of the River Medlock, it must be borne in mind that these experiments will form no criterion of the quantity required for effecting this object with ordinary sewage water.

The chairman of the Leicester company estimates a consumption of lime of 100 tons per week for a population of 500,000, which, with an ordinary water supply of 200 gallons per head per week, would be equivalent to 1 ton per million gallons of sewage.

In Mr. Stothert's patent process, the sewage is treated with sulphate of alumina in addition to the lime, which causes a rapid subsidence of the solid matters, and to these, charcoal, made from solid sewage, is added. These ingredients cost 30*s.* per ton and they are stated to make 2 tons of manure.

A small model establishment was put up by Mr. Stothert at Northumberland Wharf, Strand, where the sewage from one of the main outfalls of the Metropolis was operated upon for a considerable period, with apparently complete success so far as deodorization was concerned, but I am not aware that any other works have yet been erected under this patent.

Mr. Herapath's process consists of the admixture of sulphate of iron and burnt magnesian limestone with the sewage. This process was put in operation for a short time at St. Thomas's, Exeter, by a person to whom a lease of the sewage and of certain tanks erected at the outfall was granted by the Local Board. The contractor, however, having no capital, soon failed in his undertaking.

The proportion of materials used is 1 of sulphate of iron to 4 of magnesian limestone. Founded on the experience obtained at St. Thomas's, Mr. Herapath estimates the cost of the materials, including labour and fuel for the manufacture of the manure, at 17*s.* per ton. One ton of the ingredients will produce 2 tons of dry manure.

I must add that the operation was conducted at St. Thomas's in a very slovenly manner, and at the time of my inspection was, by no means, calculated to improve the sanitary condition of the neighbourhood.

The method proposed in Mr. Richard Dover's patent, consists in "treating sewage with an acid or acids, either alone, or together with a salt or salts or other chemical agents, for the purpose of depriving it of its putrescent qualities, and also obtaining certain products therefrom." Hydrochloric acid is named, with chloride of sodium and protosulphate of iron. The sewage is then to be filtered through charcoal, gypsum, or clay, and mixed with these are various other materials to form compound manures.

Two other patents of more recent date must not be passed over, as they have already claimed much favourable notice in the North, namely, the disinfecting powder of Dr. Angus Smith and Mr. McDougall, of Manchester, and the process of Mr. Manning, of Leith, for treating sewage.

The agent prepared by Dr. Angus Smith and Mr. McDougall "is a compound of two acids and two bases. The acids are sulphurous acid and carbolic acid, and the bases magnesia and lime. These four exist in it as two salts, viz., sulphite of magnesia and lime, and carbolate of lime." These ingredients are said to remove entirely the noxious emanations, the sulphuretted and phosphoretted hydrogen, from fæcal and other organic matters, and at the same time to preserve the fertilizing elements, the phosphoric acid and ammonia.

Of the deodorizing power of this agent under various circumstances, and of its convenient form for use, there appears to be abundant testimony. The Borough Engineer of Liverpool has used it in cesspools with great success, and it seems admirably adapted for use in stables, and for preventing noxious emanations from cesspools and from solid manure or other decomposing substances; and it is said that it could be *economically* applied at the outfalls of town

drainage for the deodorization of the sewage and its preparation as manure, although this does not appear to have been actually determined yet by trial on the large scale. The price of the material is 10*l.* per ton.

Mr. Manning's material is prepared from alum shale, containing sulphate of iron, and animal charcoal in equal quantities. Its use has been adopted at Edinburgh and at the new gaol near Liverpool with considerable success as a deodorizing agent.

These ingredients are stated to cost 7*s.* 6*d.* per ton, and including carriage, the cost of deodorizing 1,000 gallons of sewage will be a penny, or say 1*s.* per head per annum, and according to the analyses of Dr. Penny, a valuable manure is the result.

The actual working expenses at the new gaol near Liverpool were 50*l.* per annum for the deodorization of 12,000 gallons per day, including the digging out of the solid and carting away.

The process originally conducted at the outfall of the new drainage works of Croydon was that of mechanical separation of the solid matter from the liquid by passing the sewage through perforated plates or strainers. The liquid was then allowed to flow off, and the solid was mixed with peat charcoal. Various causes led to the failure and abandonment of these operations, and an action having been brought against the Local Board for pollution of the river Wandle, various endeavours have, I believe, since been made by them to arrive at more satisfactory results.

I visited the outfall again last year, when it was still by no means free from nuisance; but the works were then in a transition state. They had recently been let for the carrying out of a new process.

It was proposed to treat the sewage with lime in alternate reservoirs within the building at the outfall, in which the chief precipitation would take place, the effluent water being made to travel afterwards through a long course of open brick channel, constructed in parallel lines, the water flowing along it backwards and

forwards before discharge into the river. The solid matter was to be mixed with various other materials, to form manure of different qualities and description.

An action in the Court of Queen's Bench having been a few months ago decided against the Guardians of the Clifton Union near Bristol, for an alleged nuisance arising from the drainage of their Workhouse, Mr. Blackwell, the engineer, was called in to advise on the means to be taken for deodorizing the sewage, and the following process was adopted.

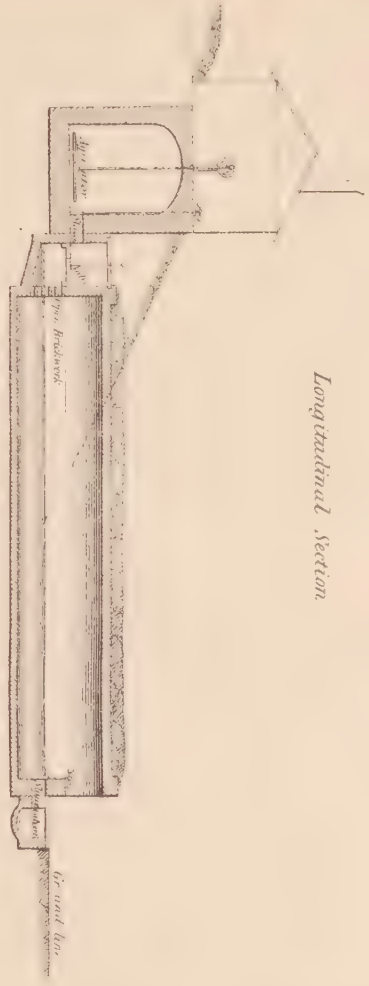
The inmates of the workhouse number 608 on the average, and the actual liquid sewage from the establishment appears to be only about three gallons per head.

Mr. Blackwell's examinations led him to consider that lime and sulphate of iron would be the best deodorizing ingredients, but that a larger quantity of water would be required to obtain the desired effect.

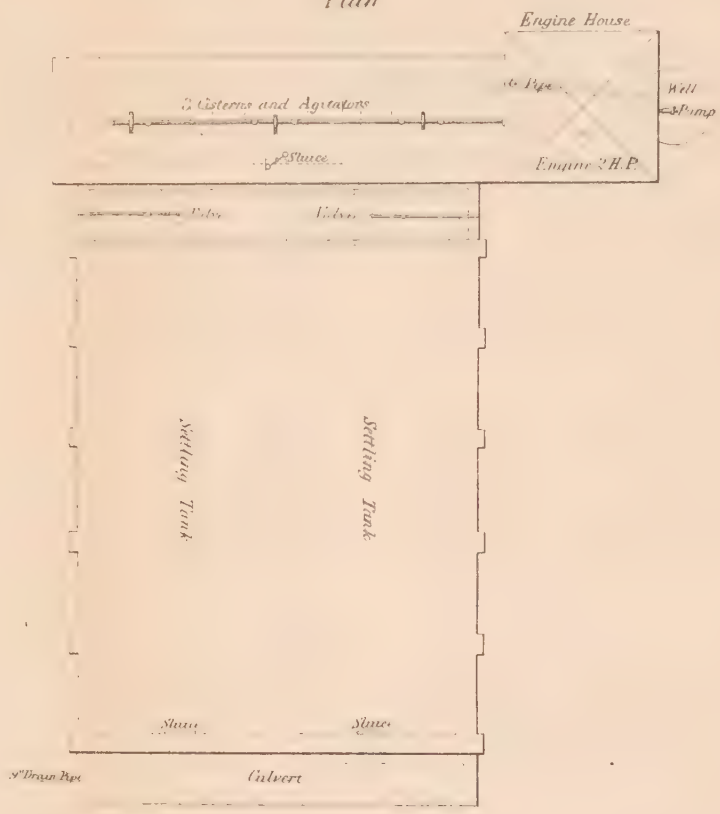
At the outfall of the sewage from the house a well was sunk and a small steam engine about two-horse power erected for raising the additional supply of water, of about four times the previous quantity, into the cisterns in which the sewage is received. When these cisterns are full, the lime is first thrown in and agitated with the sewage by a kind of churn apparatus worked by the engine, then the sulphate of iron is added and treated in the same way. The contents are afterwards run off alternately into one of two adjoining tanks, whence after some hours settlement the water is allowed to flow off to an open stream which runs into the river Froome.

The operation of mixing takes place twice each day, each of the two tanks (together containing about 10,000 gallons) being filled and discharged every 24 hours. The cost of the works was about 600*l.*

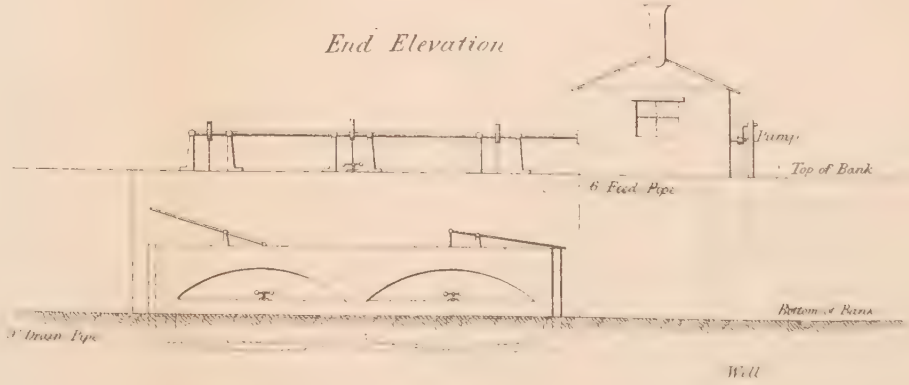
Six bushels of lime are used per week, and $2\frac{1}{4}$ cwt. of sulphate of iron. One man's time is occupied in the operation. The total working expenses, including coals and all materials and labour, may be calculated at about 94*l.* per annum, and if the interest and wear and tear be assumed to be 45*l.*, the total cost of the



Plan



End Elevation



CLIFTON UNION.

SKETCH SHEWING DEODORIZING APPARATUS.

16 feet to the inch.

Day & Son Lith.rs to the Queen.

operation would be about three shillings per head per annum; but with a more copious supply of water, for which arrangements are now being made, it is expected that the cost will be less. The solid deposit is removed from the reservoirs about once per month, but it has scarcely yet been applied as a manure. I apprehend that it would be of little service for that purpose.

I give a plan of these works (No. 1) as an instance of the compactness with which deodorizing arrangements may be established for small populations.

I found a perceptible smell from the sewage in the reservoirs after the operation was performed, arising probably from the disengagement of the ammonia by the lime, but the works may be said to have accomplished their object, as no complaint whatever has been heard since their establishment from the parties residing near the open stream below, who indicted the Guardians for the previous nuisance.

The sulphate of iron, I presume, would not be a beneficial addition to the manure, and other substances equally efficacious as deodorizers, to which that objection does not apply, being at command, its use is not to be recommended.

For this reason, also, I do not propose to enter upon any account of other chemical agents long used for deodorizing, such as chloride of zinc and nitrate of lead; for however valuable their properties for dealing with specific cases of decomposition, they would render the sewage unfit for use as a manure, and would involve therefore perpetual waste and additional expense.

2. *Mechanical Processes for separating the Solid Matter of Sewage.*

Among the works which have been established for the mechanical separation of the solid matter of the sewage from the liquid by straining or filtration, and applying it as manure, those of Cheltenham appear to be the most extensive, and at the same time most successful.

There are two outfalls of the sewage at Cheltenham, and works have been established at each of them.

For the more ready comprehension of the following description, I append a plan (No. 2) of the construction at the principal outfall.

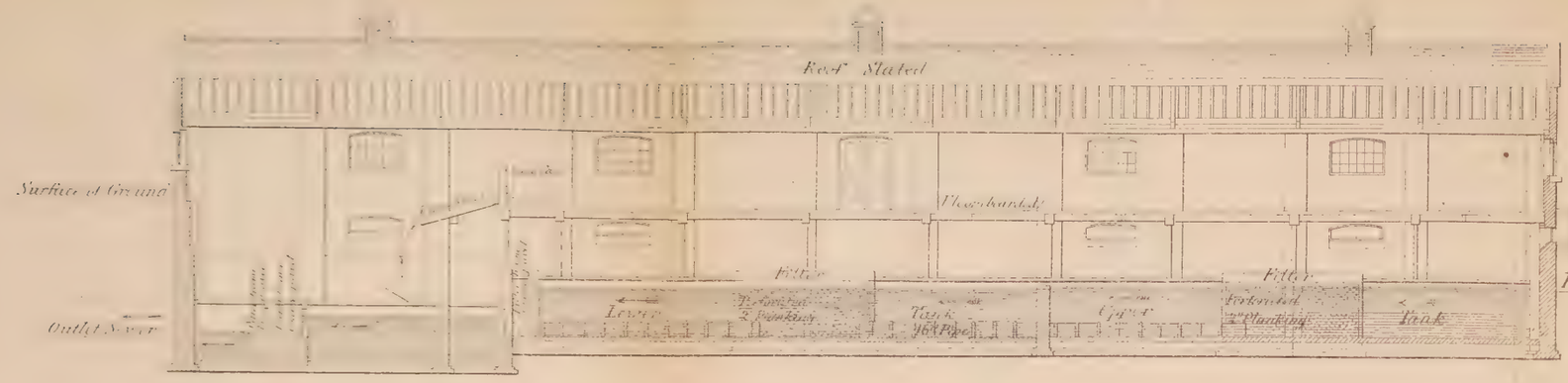
The building is divided longitudinally, forming below ground two sets of reservoirs or tanks, which are employed alternately. The sewage passes through vertical filters in the upper and lower tanks, whereby the great bulk of the matters in suspension is separated and retained. These filters are 5 feet deep and 2 feet thick, and consist of coarse gravel inclosed within 2-inch perforated boards, these being protected with basket work to prevent clogging.

The heavier matters of the sewage deposit themselves at the bottom of the tanks, but a large proportion of the solid forms itself into a floating body, and accumulates to about 18 inches thick on the surface. The liquid is conveyed from the angular filters in the upper tanks by a line of pipes in each division.

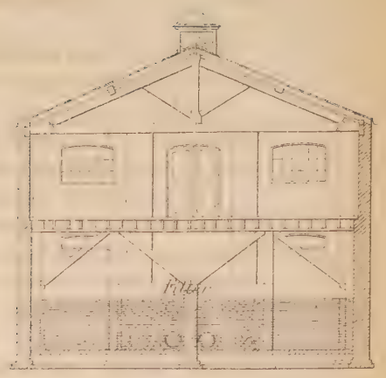
A weir, or rather division in the third or liming tank causes the water, then partially clear, to flow through a channel at each end, during its passage through which a certain proportion of cream of lime mixed on the floor above falls into it, and occasions a further precipitation to take place. The effluent water then passes through another filter of gravel finer than before, and then through a third, finer still, to the outfall.

When either reservoir contains a certain amount of solid matter, the flow of sewage is cut off and turned into the other. This takes place about every eight weeks, and the filtering medium of gravel is removed at the same time and washed. The contents of the tanks which are in a state of "slush" are then hoisted in buckets through the trap lids on to the floor above, and wheeled out and mixed with the scavenger's refuse of the town, the ashes, street sweepings, &c. These are brought to the yard, and a kind of embanked reservoir is formed of them immediately outside the building, and as the semi-solid sewage is wheeled into the midst, the dry refuse outside is turned on to it.

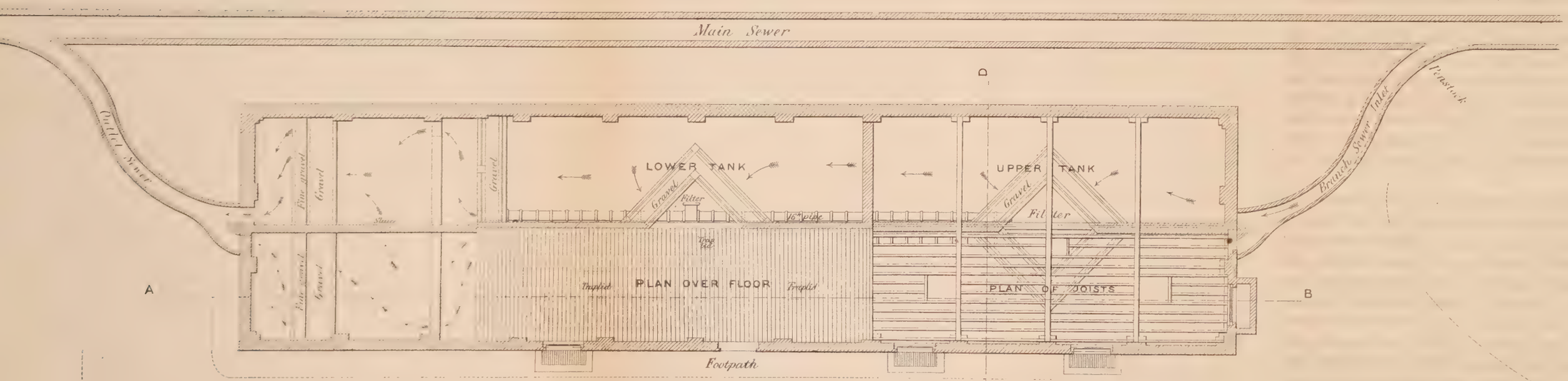
CHELTENHAM SEWAGE WORKS.



LONGITUDINAL SECTION THROUGH TANK ON LINE A TO B.



TRANSVERSE SECTION ON LINE C TO D.



Scale 16 feet to an inch.

The liquid is at once absorbed, and after being turned over and thoroughly intermixed, the solid mass is fit for immediate removal and use.

The ashes and dry refuse of the town are said to be just about sufficient for the purpose. They absorb about two-thirds of their bulk of sewage; that is to say, that one cubic yard of the ashes, &c. and two-thirds of a cubic yard of the semi-fluid sewage, make only 1 cubic yard of solid manure.

This operation was commenced in the spring of 1855. The drainage of Cheltenham is not yet by any means complete, but already the manure is manufactured at the rate of about 2,000 cubic yards per annum.

None of the lime deposit had been removed at the time of my visit. This addition to the process had only recently been adopted. The cost of it is about 14*s.* or 15*s.* per week.

The outlay upon this building was about 1,250*l.* The houses draining to it number about 3,200, discharging about 300,000 gallons in 12 hours of daytime. The cost of the operation at the outfall is found to be 2*s.* 2*d.* per cubic yard of manure, and the ashes are worth 8*d.* per yard. The Local Board wisely put a very low value on the manure in the first instance. Up to the time of my visit it had been sold at 2*s.* 6*d.* per yard, but as the demand exceeded by two or three times the supply, it was intended immediately to raise the price. Three and sixpence per yard would pay the working expenses and interest on the outlay.

As the first attempt of the kind, I must observe that Mr. Dangerfield, the local Surveyor, has carried out this work very satisfactorily, but further consideration dictates some improvements in a sanitary point of view, and in economy of construction and saving of labour, to some of which I shall beg to draw attention in another part of my Report, as they may be useful for future guidance, more especially to small towns.

The operation did not appear to give rise to any nuisance, and the effluent water and solid sewage were nearly free from unpleasant odour; but the process may, in my opinion, be conducted in so com-

plete a manner as to obviate the slightest offensiveness even in the hottest weather.

Similar works to those at Cheltenham have just been adopted by the Local Board of Health of Coventry.

The Local Board of Health of Uxbridge being much pressed by an injunction prohibiting the discharge of the sewage of that town into the River Colne without its being deodorized, constructed works for this purpose.

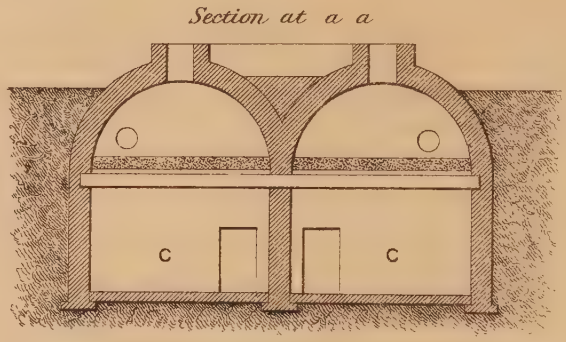
The sewage is received into a large tank arched over. As much of the solid matter as can be collected is dragged by a rake out at a door at the end of the tank. This refuse is here spread on the ground and covered with a thin layer of charcoal or earth, and is then conveyed away in carts by the farmers. The liquid refuse flows from the tank through boxes filled with peat charcoal in lumps of 3 or 4 inches. It simply passes through these boxes and runs direct to the river.

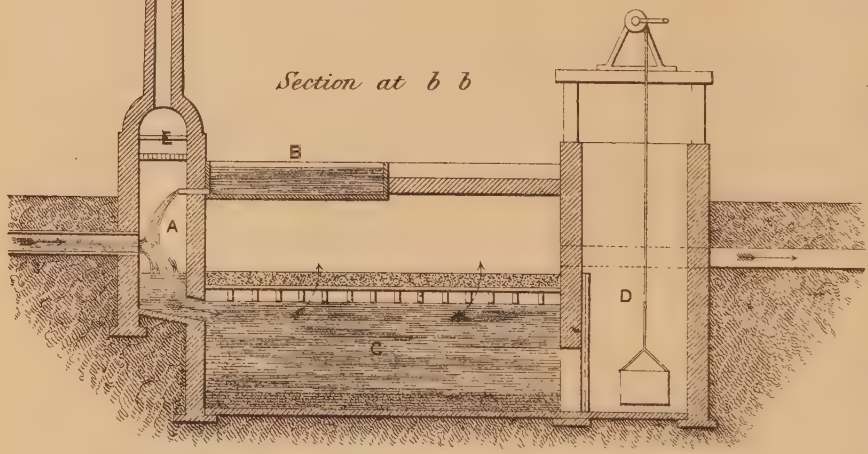
I refer to this case more as an example not to be followed than as one possessing any merit. Although considerable expense has been incurred in constructive arrangements, which are sufficient for complete deodorization, care has not been taken to collect information as to processes which have been found effective, and it is not surprising, therefore, that the Local Board should still be in legal difficulties on the subject. Endeavours are now being made, however, to rectify the errors into which they have been led.

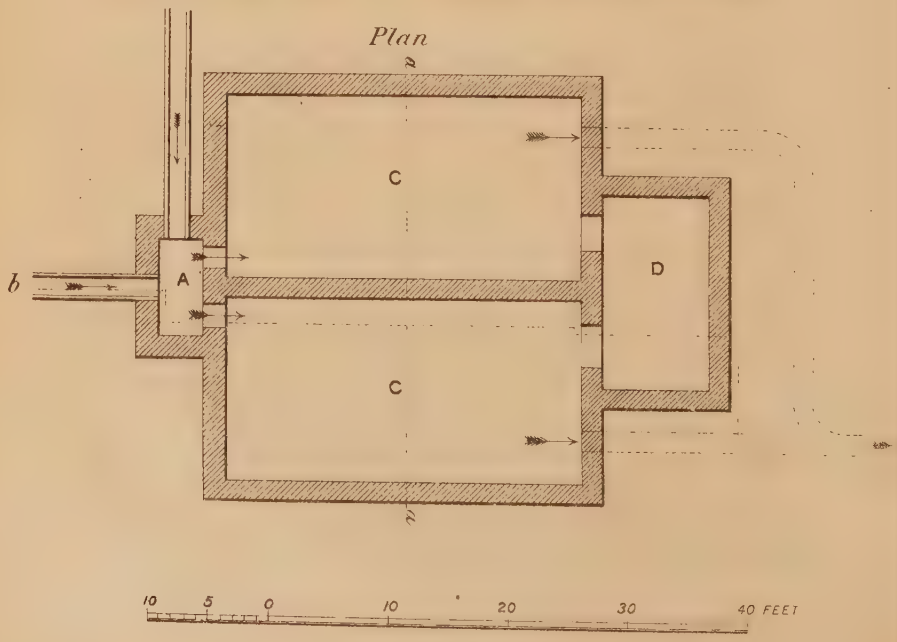
There are about 1,500 houses in the town of Uxbridge. An examination of these works took place when about 500 only of the houses were connected with the drainage, and it was then found that the liquid refuse running into the River Colne was much discoloured, and the appearance of the ground showed evident symptoms of deposit of an unpleasant character.

The Local Board are restrained by the injunction from turning lime water into the river, on the plea

SEWAGE WORKS___ELY.







that it would destroy the fish; but the experience at Leicester shows that this is not a necessary consequence of treating the sewage with lime. There, however, the lime water does not enter the river; sufficient reservoir space is allowed for its precipitation before the effluent water is discharged.

Mr. Burns, the local Surveyor of Ely, having, as early as 1834, made some successful experiments in treating gas water with clay, was induced recently to apply it, in conjunction with lime, for deodorizing the sewage, on completion of the drainage works of Ely. Sewage works have been erected at the outfall in which the experiment has been in operation for some time, and it is stated with complete success. At the time of my visit the place was certainly quite free from offensive smell; but the collecting tank has not yet been opened to try the effect of the manure.

It is found that one ton of clay is sufficient to deodorize 600 tons of sewage as at present discharged at Ely; but, as only a portion of the houses have waterclosets as yet, the liquid is comparatively weak. It is expected that every house will in the course of the present year be connected with the sewers, when it is supposed that about double the weight of clay will be required for the same quantity of sewage.

As the sewage discharges into the mixing tank A (Drawing No. 3.), a stream of clay water falls from a cistern B above, and passes with the sewage alternately into one of two reservoirs C below, whence the water filters upwards through a layer of charcoal and sand, and discharges by the outfall drain to the river.

It is proposed to pass the solid matter daily into the emptying chamber D, and to mix it with dry clay powder and peat charcoal, or with fine dry ashes, when it will be fit for removal and use as manure.

The furnace E shewn in the section is intended for consuming the foul gases from the sewers, and for heating an oven for drying clay and peat for mixing with the wet manure. When the drainage works will be complete it is proposed to add a series of open tanks, with other filters of charcoal and sand,

through which the effluent water will pass before discharge.

An attempt has been made for some time at Hitchin to intercept the solid matter of the sewage in a series of reservoirs and open pits at the outfall of the new drainage works, without any means of deodorizing, or arrangements for precipitating, straining, or filtering. As might be expected, the process has not been successful. An action has been decided against the Local Board for pollution of the river, which will necessitate the adoption of more complete arrangements.

The gas for lighting the Dartmoor Prison has been manufactured for the last five years from the peat with which that neighbourhood abounds, and some very interesting results are being elicited in the process by Mr. Watts, the Resident Engineer, by whom the system was introduced.

The peat charcoal and the ammoniacal liquor, two of the products of the manufacture, are mixed with the solid night-soil of the establishment, and with bone-dust, to form a solid manure, which is used on the neighbouring lands.

The liquid refuse of the premises is pumped up and applied for irrigation, as will be described further on.

It may be useful to mention, with reference to the manufacture of peat charcoal, that one cubic yard of the dug peat makes about 4½ cwt. of the dried material, and that 5 cwt. of charcoal are produced from 1 ton of the dried peat.

As so much disagreement prevails with respect to the deodorizing power of peat charcoal, Mr. Blyth was instructed to make some experiments on the subject, and to determine the comparative value of peat charcoal and the ground Boghead coke for this purpose. I append Mr. Blyth's report (App.B.) on this examination. The results obtained are of considerable interest.

It appears that neither of these substances has much deodorizing power when mixed with liquid. When heated after saturation they both gave off offensive effluvia in abundance, but, when spread over the surface of offensive matter, the escape of all odour was prevented. The experiments show that they have no power to separate matters from solution, and thus confirm the previous statements of Professor Way and Dr. Henderson that the power of charcoal to absorb ammonia from the atmosphere does not extend to the separation of that gas, or of anything worthy of notice, from solution.

In condensing gases, or as a deodorizer of atmosphere, the peat charcoal appears to have about four times the power of the Boghead coke; but, on the other hand, it must be borne in mind that, whereas the peat charcoal has latterly cost in London between 4*l.* and 5*l.* per ton, the ground Boghead coke is to be had for 12*s.*

In the course of these experiments a valuable property of the Boghead coke was discovered. It is only with great difficulty that this material can be made to mix with water; it remains a floating mass on the surface, and it was found that in that position it has considerable power of promoting evaporation of the liquid below, while effectually condensing the odorous gases that would otherwise escape. It thus becomes of value in promoting the drying up of offensive deposits. The sample of the Boghead coke was obtained from the Chartered Gas Company's works, Horseferry Road, a certain portion of this coal or bituminous shale being now very generally used in the manufacture of the London gas.

3. *Deposition of the Solid Matter of Cesspools; and the Separate System of Drainage.*

The simple deposition of the excremental refuse of towns, and the draining off of the liquid from the solid mass, as the means of manufacture of a portable manure, is carried out on the largest scale in Paris. A full and able report upon these works was prepared by

Mr. Rammell, C.E., and is comprised in the Appendices of the Water Report (1851) of the first General Board of Health. It would be needless, therefore, under any circumstances, to enter into any detailed description of that operation here; but it is, in truth, so utterly inapplicable to the mode of drainage which I assume to be indispensable for the health of town populations, and constitutes so great a nuisance in itself, that I should scarcely have considered it necessary to allude at all to this method of dealing with the matter, had it not still been doubted by many whether that system of drainage can itself be right which leads to considerable difficulties in realizing the full value of the refuse of town populations.

I fear that all such objectors who would revert to the cesspool system view the subject with agricultural or commercial sympathies, rather than with an anxious regard for the public health as the primary consideration. At least they must be ignorant of the overwhelming evidence which a long course of inquiry has brought to light of the evils sustained by the retention of town refuse about habitations.

Some will admit these evils, but maintain that they arise from carelessness and defective arrangements both for the retention and removal. So far as this country is concerned, these defects, whether of construction or transport, must be admitted; but the Paris arrangements are the very perfection of the system. No care or expense has there been spared, and yet it is proverbial that the great source of the noxious atmosphere in Parisian houses is the cesspool.

Admitting this danger, even with the best arrangements, some will ask, is not chemistry equal to the control of these substances,—either to prevent their passing into a dangerous state or to convert them into innocuous and valuable fertilizers?

Granting this power to chemistry, we must bear in mind that any arrangement made with this view, must receive daily proper attention in every separate household; and, supposing this to be given, cost of the necessary arrangements and collection would exceed the difference of value between the refuse in

this more solid form and that in which it is presented at the outfall, diffused in a large body of water.

The middensteads of Liverpool and Manchester are an example of this kind of treatment. These places receive daily the ashes and the privy refuse; they have of late years been drained, and have received constant attention in other respects, with the view to make the best of them. The ashes themselves form an excellent deodorizer when properly used, and yet the rate of mortality in both of these towns seems to me to support the conclusion of those who contend that a high standard of health is not to be expected until the water-closet has been generally substituted for the middenstead.

Sharing in this conviction, I shall not consider the cesspool system further. The deposition of the refuse and draining off of the liquid practised in the neighbourhood of Paris, whereby the portable manure "poudrette" is obtained, is practicable only as part of that system, and is itself, at best, a most offensive operation.

With the method of town drainage now established in this country, arrangements for deposition of the solid matter of the sewage at the outfall would be insufficient as a sanitary operation, as the attempt at Hitchin has shown; nor, if this could be admitted, would the solid possess anything like the value of the Paris deposit, the chief value of the matter in our case being in solution in the water. Here, indeed, we may invoke the aid of chemistry, to render that value again available in all towns and places in which the liquid itself cannot be applied to the lands; and we may reasonably hope that the great attention which the importance of the subject has for some time secured to it from scientific men, will, ere long, be crowned with greater success than has hitherto been attained.

From the foregoing observations,—first, as to the constituents of the sewage of towns, and, second, as to the state of dilution in which alone it is available

either for solid manufacture or for direct application to the land in the liquid form,—we may judge of the difficulties which present themselves in realizing the value of this manure, however well determined that value may be.

Having alluded to the opinions of those whose remedy for the difficulty would consist in reverting to the cesspool system,—modified and improved of course, but in any case a system, in my opinion, incompatible with a due regard to the public health, even if preferable in the interests of agriculture,—I come to a further difficulty in the question, namely, the additional dilution of the sewage by rain. For the remedy of this, what is called "the separate system of drainage" has long been strenuously advocated.

The difficulty of this increased dilution is at first sight so great in practice, and the remedy so obvious and simple in theory, that I purpose to offer a few observations on the subject, feeling satisfied that the proposition of two separate systems of drainage, one for surface waters and another for house refuse is founded on a mistaken view of the question.

First, as to the extent of dilution by rain water, which has to be considered.

Because a certain amount of rain falls in the course of the year at a given spot, it is not to be assumed that this represents the daily addition of water to be applied to the land, or from which the sewage constituents have to be disengaged.

An annual rainfall of 24 inches, equally distributed, would amount to about the same quantity per head as the usual water supply of the population of a town, namely, 25 gallons per day. Whatever the amount of rainfall, however, considerable deduction must be made from it for evaporation. On examination of the registers of rainfall, it will be found, moreover, that a very large proportion of the whole quantity of rain usually falls in a small number of days of the year, which of course may be discarded from calculation altogether; for on those occasions of flood, or storm, there would be no attempt, after the first

flushing of the sewers, to make use of their contents. Conveyed in such an enormous bulk of water on those few days, the sewage would be innocuous and of no service for manure, and therefore might safely be allowed to pass off direct to the outfall.

Taking some years' registers of rainfall in the metropolis at hazard, I find that about *one-half* * of the total rain fell in from twenty to thirty days of the year, and such days will naturally be eliminated from calculation, with reference to the distribution of the sewage. On half the remaining number of days in which rain fell, the quantity would not have exceeded the usual daily water supply, and the maximum fall upon other days was only such as should, with proper arrangements, be usually under command for distribution.

Mr. Walker, at Rugby, has scarcely been deterred at all by rain from pumping all the sewage that he could on to his land, for, except during one period of frost, he has worked on regularly for 300 days of the year; stopping, therefore, (Sundays of course being excluded,) for only thirteen days on all accounts. So far as the quantity of water thus distributed over the land is concerned, even if the whole of the usual rainfall on the site of Rugby, in addition to the town water supply, were applied to Mr. Walker's land, *it would not be above one sixth of the bulk of water which is regularly applied to the Craigentinny Meadows in ordinary working.*

It is obviously desirable, on agricultural grounds, to avoid as much as possible any dilution by rain of the already greatly diluted sewage; and all land water, drainage of suburban roads—in short, all waters free from pollution—should *as far as practicable*, be excluded from town sewage. Allow me, however,

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* I find this fact more completely confirmed by Mr. Beardmore in his hydraulic tables. In the register of 17 years' rainfall at Boston, the average annual fall is seen to be 22·30 inches, and 11·03 inches fell within 24 days. In the register of 16 years' rainfall at Glencorse, where the much heavier quantity of 37·38 inches fell in the year, 25·61 inches, or more than two-thirds of the whole, fell within 42 days.

briefly to consider what advantage would really be obtained by the separate system of drainage applied to a town.

To what area is the separation to extend? What will it amount to? If it is to be a separation of the drainage of all public streets, and other public areas of all kinds, from that of private properties, I have been at some pains to discover what proportion these bear to each other, and I find, from the admeasurement of these areas in eleven separate towns of various population, that the average extent of the public surface is not one-fifth of the area of the private property, or rather of that portion of private property to which the drains would extend. By separation to this extent, therefore, four-fifths of the rainfall would flow to the original sewers with the house drainage, and one-fifth to the new or rain-water sewers.

But if the system is to extend, in addition, to private properties, where is the separation to take place? A complete double system of house drainage would be necessary. Will the interior of the house be drained to the refuse sewers, and the exterior to the rain-water sewers? the stable yard with its dung-pit to the one, the stable itself to the other? Or will the waste from the wash-house sink, and that from the accumulations in house yards of the lowest class, where the scavenger rarely enters, drain their several ways?

It is manifest that the separate system, if by it we mean the division of a clear water drainage and a foul water drainage, is simply impossible; but were it not so, it would simply be, in the agricultural view, a question whether it would be cheaper to construct this costly system of complicated works, than to apply the useless rain-water to the land, or to waste the sewage on wet days. But it will be observed that the distribution of the additional quantity is not all profitless expenditure. Large quantities of manure are at all times brought down from town surfaces by rain, although the street washings will not often be found anything like so rich in fertilizing elements as

were those of the metropolis examined by Professor Way.*

There is no sufficient evidence of the precise value of these elements; but there seems reason to suppose that at all ordinary times a very large addition of manure is thus washed down with the house sewage. This fact is the more obvious to those who have given much attention to the subject, from the evidence which is constanly presented to them of the rapidity with which stagnant water from street surfaces becomes extremely offensive, although kept perfectly distinct from other drainage. During repeated examinations, some of the foulest emanations I have experienced were from places with which no house drainage whatever was connected; the noxious smell came from the surface refuse only, washed by the rain into gullies and catch pits.

And this consideration leads me to the main objection to this proposed separate drainage, namely, that we should have two foul systems of sewers and house drains instead of one; at the best, two sources of foul atmosphere ramified over every town, and each the more dangerous for that very separation. So that even if the interests of agriculture loudly demanded this treatment of the case, and the enormous cost were not an object, REGARD FOR THE PUBLIC HEALTH WOULD FORBID IT.

In short, the public would be called upon to incur double expense for a source of great and decided danger to their health, and a very questionable advantage to agriculture.

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* The objections to the separate system are far stronger in the metropolis than in provincial towns, both on agricultural and sanitary grounds. In the first place the rainfall does not bear so large a proportion to the water supply, and in the next, it becomes much richer in manurial elements, or in other words, much more foul and noxious than in less crowded places.

The Utilization of Sewage in the Liquid Form.

I shall now proceed to a description of the methods employed for utilizing liquid sewage as it flows to the outfall.

The methods of application of liquid sewage to agriculture fall under two divisions:—

1st. the system of open irrigation, which has been practised in some places for many years; and,

2nd, the system of underground pipes, and distribution by moveable hose and jet, which has been brought into practice only within the last few years.

1. *The System of Open Irrigation.*

Of the application of sewage by open irrigation the Craigentinny meadows at Edinburgh certainly form the most striking and successful example.

The area of land in question consists in all of about 260 Scotch acres, the Scotch acre being rather more than an acre and a quarter English. They are irrigated with the waters of the "Foul Burn," into which about half the City of Edinburgh is imperfectly drained.

Over the "Old Meadows," which comprise about 180 acres, the sewage is said to have been so applied for these sixty years. This land lies somewhat on a gentle slope. It was partly drained some time ago. I was informed by the Superintendent that these drains were, in his opinion, rather an injury than a benefit, as they carried the liquid too rapidly from the land. Mr. Oliver, however, under whom the drainage was carried out, believed that he derived great advantage from it, as it permitted the water to percolate the soil to a greater depth than it otherwise would have done. Another informant states, no doubt with much truth, that if, on the one hand, the sewer water is allowed to form pools on the land, the crop is destroyed, or the yield is small in quantity and bad in quality; but, on the other hand, in very dry seasons, the exits of the drains require to be plugged up in order to retain a sufficient degree of moisture in the land.

The soil of another portion of the meadows which was laid out about thirty years ago consists of sea sand, which, before the irrigation was commenced, was very nearly barren and worthless. The whole of this land is irrigated by gravitation from the Foul Burn, but another portion, consisting of about fifty acres, lies above that level, and to this the sewage is raised by a steam engine of about eight-horse power.

The sewage water is conducted to the Old Meadows by open channels or ditches, following the levels of the ground; but the level lands more recently irrigated are divided into panes of about half an acre each, over which the water is successively conducted.

The irrigation goes on incessantly, except on Sundays, all the year round, winter and summer. Two men complete the irrigation of all the lands supplied by gravitation in about three weeks or a month, and then work through it again. The operation is conducted night and day, and a weekly return made of the work done.

No other manure is ever applied to the irrigated lands.

Each irrigation of the 50 acres of high level land is completed in about ten days.

The quantity of water discharged over the low lying lands in the course of the year must be enormous. I had no opportunity myself of testing the ordinary flow of the Foul Burn, as there was incessant rain during the whole period of my visit; but it has been estimated at 220 cubic feet per minute. The Superintendent informed me that it is never allowed to run to waste except in times of excessive floods. There are not many days in the year in which a greater amount of rain would fall than during my visit, and the irrigation was then proceeding as usual. If it be only assumed, however, that the quantity which comes down in dry weather is applied during nine months of the year, deducting the Sundays as well, there will, on the above calculation, be passed over the meadows annually a depth of water between six and seven feet; and yet the Superintendent states, that the fertility is invariably in proportion to the quantity of sewage employed.

"The more water each portion receives the larger is the crop raised on it, and the higher the price got for that crop in the market."

The higher level lands do not get nearly the same quantity, because of the expense of pumping, and the results are proportionally less.

I could perceive no trace of effluvium from any part of the *land* under irrigatiou at the time; but although it was cold weather, sufficient smell arose from the *ditches* to indicate that in summer time they must become highly offensive. I agree in the conclusion arrived at by several previous observers, that the solid deposit in these channels has been the cause of all the complaints that have been made of these works of irrigation, and I believe that the evil, under a better system and with greater care, may certainly be obviated. I shall have to allude further to this point in another part of my Report.

The solid deposit is at times cleared out from the ditches at Edinburgh, and is used with other manure on other parts of the farm.

The laying out of these meadows for irrigation is said to have cost from 6*l.* to 30*l.* per acre; the chief portion of the work, that of the old meadows, having cost 15*l.* per acre.

The drainage of the town of Tavistock was undertaken at the cost of the Duke of Bedford, and completed about six years ago. During its construction about 90 acres of meadow land were prepared in catch meadows and beds for the purpose of irrigation with the sewage of the town. About 10 acres only of this land were drained.

Mr. Benson, the Duke's steward, in a communication to the first General Board of Health, in September 1851, says:—

"There are only 50 waterclosets in Tavistock which are supplied by water, and which communicate with the sewers. There are, however, a considerable number of privies, the drainage of which goes more or less into the sewers; as does also the drainage from various stables, pig-houses, slaughter-houses, and

other premises. It would, however, be impossible to estimate the proportion of fertilizing matter which the occupiers secure to themselves, and how much is allowed to escape into the sewers. It is, however, supposed that the greatest portion of the privy-soil, and the whole of the housewash of about 500 dwellings, is carried into the sewers; a great portion of the houses having drains from the premises direct to sewers, while others are merely drained on the surface, and the waste arrives at the sewers with the wash of the streets."

At the time of my visit to Tavistock, in December 1855, about 70 additional waterclosets had been admitted to the sewers, and about 30 new houses.

There is nothing particular in the formation of these meadows; they are irrigated by two main open lines of gutter, an upper and a lower level, from which the subsidiary channels lead. These carriers vary from 1 foot to 3 feet in width, and seemed to me considerably wider than necessary I could not help remarking, also, the considerable slope at which the beds are formed, which I should think must carry off the water much more rapidly than desirable.

An ample supply of water has been provided for Tavistock at the Duke of Bedford's expense, and the sewage appeared to be in the usual state of dilution for dry weather; but the solid matter is entirely disintegrated before reaching the outfall, owing, no doubt, to the amount of friction to which it is subject in the angular-shaped inverts which have been adopted in the sewers here.

The sewage is applied to the meadows throughout the year, winter as well as summer, but not in the continuous mode adopted at Edinburgh. At certain seasons, therefore, and when the grass is high, much of the sewage is allowed to run to waste in the river.

It was cold weather at the time of my visit, but there was a perceptible, although not a strong smell of sewage in the meadows. The little offensiveness there was seemed attributable to a considerable amount of deposit at the outfall and along the course of the channels.

The Duke of Bedford formerly held 25 acres of this irrigated land himself, but the whole 90 acres are now in the hands of two tenant farmers.

The cost of these irrigation works appears to have been a little over 13*l.* per acre, and the working expenses about 15*s.* per acre per annum.

At the town of Harrow, which has been drained under the Public Health Act within the last few years, the sewage has for some time been applied to neighbouring grass lands by surface irrigation; but very little has been done by way of works for this purpose, nor is the sewage yet employed with anything like system for the production of the utmost effects, although the favourable position of the lands offers an admirable opportunity for doing so at very small cost.

Harrow stands on an eminence, with a rapid fall in all directions, and when the new works were first executed there were nine outlets for the drainage. The sewage at the mouths of the two main outfalls was originally stored in pits and ponds somewhat too near to the town, and complaints of nuisance arose. The pits have now been abandoned and filled up, and the two outfalls have been connected and extended in one main line of eighteen inches diameter to a point where no nuisance can be caused to the town.

All cesspools at Harrow have been removed, and soil pans and six-inch house drains have been substituted; but although waterworks have been established by a company, water has not been laid on to most of the poorer class of houses. These obtain their supply from pumps and wells as before, and there being a rapid fall, the drains are kept clean by throwing the house slops into the soil pans.

Taking into consideration, also, that a large part of the population of Harrow consists of the school establishment, the consumption of water per head must be considerably less than in other towns of which the drainage is complete, and its sewage in dry weather must be far less diluted than usual.

The sewage has been hitherto applied only on Mr. Chapman's farm in a rude manner through the spring and summer months, but with admittedly good results. It is stated to be the intention to make better and more extended provisions for its use.

Dr. Bucknill, of the Exminster lunatic asylum, Devon, has for some time applied the sewage from that establishment to some neighbouring grass land by open irrigation on a small scale, and also for promoting the growth of vegetable produce.

The sewage derived from the imperfectly drained town of Crediton has been for many years employed for the irrigation of some neighbouring flat low lying lands called "Lord's Meadows," consisting of about 32 acres.

An offensive open sewer conveys the sewage from the town, and the only discharge for it is by means of the irrigating channels through these meadows, whence it passes into certain ditches which have their outfall into the river Creedy.

Other land also, higher up, called the "Palace Meadow," and very near to some of the houses of the town, is irrigated from the same open sewer.

The irrigation goes on winter and summer, producing luxuriant growth. There is nothing particular in this case to distinguish it from the ordinary method of irrigation practised in Devonshire, except the fact of sewage being used instead of simple water.

There are many similar cases to be found throughout the country. I call attention to this one among them, more for the purpose of offering a few observations as to such modes of dealing with the sewage, when treating of the results of its application in another part of my Report.

On some other land near Crediton, which this same open sewer traverses, pits were formerly used for intercepting the solid matter of the sewage for manure, but these being found a nuisance, an action was brought by the Poor Law Guardians, and the proprietor was compelled to abandon them.

For the same reason which leads me to refer to the Crediton meadows, I will allude also to two important

cases of irrigated lands, of which particulars are given in the Report of the first General Board of Health, the catch meadows at Pusey, and the Clipstone water meadows, although I have not had an opportunity of examining them.

The Pusey meadows consist of about 100 acres of flat land, which before the irrigation was commenced, was said to be worth a rental of about 5*s.* per acre.

The expense of forming the gutters, &c., varied from 4*l.* 10*s.* to 2*l.* per acre; the cost of earthwork and labour having been much diminished in the portion more recently executed. The amount of cost was equal to an average of 3*l.* 4*s.* per acre, exclusive of sluices. These were of oak, and cost 2*s.* 6*d.* each, and ten of them were reckoned as necessary to the acre, making altogether 4*l.* 9*s.* per acre. In some parts, however, clods were used instead of sluices; but taking the expenses of diverting the stream into account, Mr. Pusey stated that this estimate could not be far wrong.

The irrigation of the Clipstone water meadows, which consist of about 400 acres, is effected by a considerable work. The River Maun, which in passing through Mansfield receives the drainage of that town, is diverted from its natural channel by a flood dike 4 yards in width, extending a distance of 5½ miles on a perfect level. At the extremity of this line a new dike commences, extending for a further distance of 1½ miles, in the course of which it receives other drainage.

The formation of the channels for irrigation is thus described:—

"The centre carriers are at right angles with the flood-dike and the river, and have a quick descent. They supply a great number of cross carriers, branching off on each side, so as to form figures, like what is known by the term 'herring-bone.' The cross carriers are level, and shed the stream over the surface from one to the next carrier successively, until it has done its work, and reaches the river.

"The carrying gutters at Clipstone are not cut out by vertical spits below the level of the ground, but are hollow dished channels, two or three feet wide, upon which the grass grows almost as freely as upon the other parts of the meadows. This has two important advantages; there is no loss of producing surface, and the cost of cleaning gutters is almost saved."

The average cost of formation is said to be at least 120*l.* per acre, which, taken at $7\frac{1}{2}$ per cent., with 10*s.* per annum added for superintendence, &c., makes a total annual charge of 9*l.* 10*s.* per acre.

The whole area of what is now water meadow would have been well let, it is stated, at from 3*s.* to 5*s.* per acre, before these works were executed. Such of the land as is now let irrigated produces a rental of 4*l.* 10*s.* per acre, but Mr. Denison, in his account of these lands, gives statistics of the produce, showing the average annual value to be not less than 12*l.* 4*s.* per acre.

It may be useful also to refer to an example of irrigation in Lombardy with the sewer water of Milan, upon which some important considerations arise. A description of these works by the Count Arrivabene, one of the Surveyors, is appended to the Report of the first General Board, and the following is extracted therefrom:—

"The city of Milan consists in three concentric circles, two of which are formed by canals constantly provided with flowing water, and the other by the town walls.

"The inner canal, or Sevese, which is the most ancient, encloses the first nucleus of the city under the Romans, is all covered, and serves only for drainage. The other canal, or Naviglio, which forms the second circle, encloses the city as it was during the middle ages, is open, and serves for navigation as well as drainage. The Sevese carries off the drainage of the two inner circles, and the Naviglio that of the external.

"All the streets of the city have along the centre a subterranean sewer in brickwork, and proportionate

in its dimensions to the body of rain water it is intended to receive, considering the length of the street and the depth of the houses on its sides. The rain from the front roofs is collected in vertical pipes fixed to the walls of the houses, and runs through subterranean gutters into the longitudinal sewers of the street. The rain from the back roofs and courts, as also the waste water from offices, provided it be absolutely liquid, flows in the same manner into the street sewer. But the houses along the two canals discharge at once into these, not only their liquid drainage, but every sort of half-liquid material proceeding from water-closets and laboratories.

"The drainage of the city being thus carried to the Sevese and the Naviglio, either by the street sewers, or direct by the gutters of the neighbouring houses, the street sewers are levelled according to the depth of the canal into which they discharge their contents."

The Sevese is cleaned twice a year, in April and September, periods at which the water of the canal is turned off.

"The Sevese derives its water from the Naviglio by means of three inlets, one of 17 inches, the other of 10, and the third of 6, in three separate spots These waters are then collected by another canal, called Vetra, which, after receiving another contribution from the Naviglio, assumes the name of Vettabbia.

"The Vettabbia flows out of the southern part of the city, and, after a course of 10 miles, discharges itself into the river Lambro, fertilizing prodigiously a considerable extent of meadow land. It can be easily conceived what must be the fertilizing quality of the Vettabbia, as it carries off all the filth of a city of 150,000 inhabitants, and the quantity of fertilizing matter borne along by its waters raises in such a manner the surface of the meadows it irrigates, as to render it necessary that from time to time the deposit should be removed from the meadow in order to preserve the level of irrigation. The deposit is by itself an excellent manure, and is bought by the neighbouring agriculturists as a fertilizer. The Vettabbia pos-

sesses also the valuable peculiarity of protecting from frost the meadows it irrigates, owing to the high temperature it receives in its passage under the town.

"The Cistercian monks were the first who turned to a profitable use the slimy waters of the Vettabbia, and introduced the system of irrigation, which forms a most important branch of the agriculture of Lombardy.

"The waters of the Naviglio, after receiving the drainage of the remainder of the city, are also applied to the irrigation of an extensive surface of land.

"It may, perhaps, not be useless to add a short description of the water meadows, which in Lombardy are called *marcite*. These meadows are divided into various rectangular zones, about 22 feet wide, by means of rectilineal channels, which serve alternately, one for irrigation, and the other for draining. These zones are arranged so as to have a slope of about six inches from the channel of irrigation to the draining channel. The waters of the feeder, which is placed on one of the sides of the meadow, at a right angle with the channels of irrigation, flow into these, and through the whole of their length spread over the zones on both sides, covering them, as it were, with a watery veil, which preserves the life of the plants and promotes their vegetation. The water of the draining channels is then collected again into another channel, which conducts it to irrigate another meadow in a similar manner. The *marcite* are irrigated in summer during a certain number of hours about once a week; and from the end of September to the end of March they are irrigated permanently, the water being only turned off when the grass is cut. During winter the irrigation of the meadows is also carried on with spring water, which landowners are authorized by law to conduct to their lands through the lands of their neighbours. To this very ancient law a great portion of the agricultural wealth of Lombardy is to be ascribed.

"Some of the meadows irrigated by the sewerage water of Milan yield a net rent of 21*l.* per *tornatura* (a measure of 10,000 square metres, equal to about

two acres and a half), besides a land tax of 61 francs 10 cents, the expenses of administration, repairs of buildings, &c. These meadows are mowed in November, January, March, and April, for stable-feeding; in June, July, and August they yield three crops of hay for the winter, and in September they furnish an abundant pasture for the cattle till the beginning of the winter irrigation."

The two cases of the Pusey and the Clipstone Meadows are cited as examples respectively of the cheapest and of the most expensive mode of laying out land for the purposes of irrigation; the formation of the Pusey Meadows having cost 4*l.* 9*s.* per acre on the average, the Clipstone Meadows, 120*l.* per acre; but in even stronger contrast to the heavy cost of the Clipstone works, I will here briefly notice the system of laying out land for irrigation introduced by Mr. Bickford, of Crediton, who has had some 20 years' experience of water meadows.

My attention was drawn by Sir Stafford Northcote to this simple yet efficient method of conducting water over lands whether of even or of undulating surface; and I beg to append to this report (App. C.) the account given of it by Sir Stafford in the Journal of the Agricultural Society of England.

I allude to this system, not because it is applicable for the irrigation of land with the sewage of towns as at present conducted; but because I desire to offer some suggestions herein-after in relation to it, having much reason to believe that with certain modifications this method may be made a most valuable adjunct.

The principle of Mr. Bickford's plan consists in so disposing of his irrigating lines, that whatever the levels, or whatever the inequalities of the surface, an equalized distribution of the flow is secured over the whole area, without any artificial formation of the ground.

This is accomplished by tracing over the land a series of very small contoured (or nearly contoured) lines of gutter, subsidiary to the main carrier, so that as each level line is filled, the water sheds equably over its edge, to irrigate the next area in succession.

It has the effect, in short, to use Mr. Bickford's own words, "of continuing (and even causing) a smooth and uniform surface to the meadow, allowing of the operations of mowing and carting over the meadow, without any sensible perception of the existence of the gutters used for irrigation."

These gutters are about 4 inches wide and 1 to nearly 4 inches deep, and obviate the necessity for the usual large and frequent level gutters. They are cut with a die fixed in a sort of plough of simple construction.

Any series of the gutters may be reached by cross feeders, without necessarily first irrigating those above, so that lower portions of ground may, whenever desired, be irrigated before the upper levels.

Sir Stafford Northcote estimates, from experience on his own land, that water meadows similarly situated might be completely laid out at an expense not exceeding 1*l.* per acre; and that the annual expense of cleaning the gutters, or of cutting fresh gutters by the side of the old ones, may be taken at 1*s.* per acre.

2. *The System of Underground Pipes.*

Distribution of Liquid Farm Manures.—Before entering upon a description of the works which have been recently laid down for the application of the liquid sewage of towns to agriculture by a system of under-ground pipes, it will be well to refer to some instances of the farms upon which works are in use for distributing artificial and farm manures in a liquid form, as these have been in operation for several years, and the arrangements since adopted for the distribution of sewage have been founded upon them, and are of very similar character.

The cases of this class comprised in the appended list (App. D.) have been brought to my notice, but other instances no doubt now exist, so much attention having of late been given by agriculturists to the advantages obtainable by such works.

It would not have been necessary for the purposes of this report, even if it had been practicable for me, to visit the whole of these establishments. Some of

those which had already been described in the report of the first General Board (made in 1851), it seemed desirable to visit, in order to observe any further points of experience which might have been gained. I shall confine myself, for the most part, with regard to these places and to others I have also had the opportunity of inspecting, to such points as may seem to bear upon the immediate object of this report, namely, to afford useful information for guidance in the laying out or management of similar works for the application of the sewage of towns.

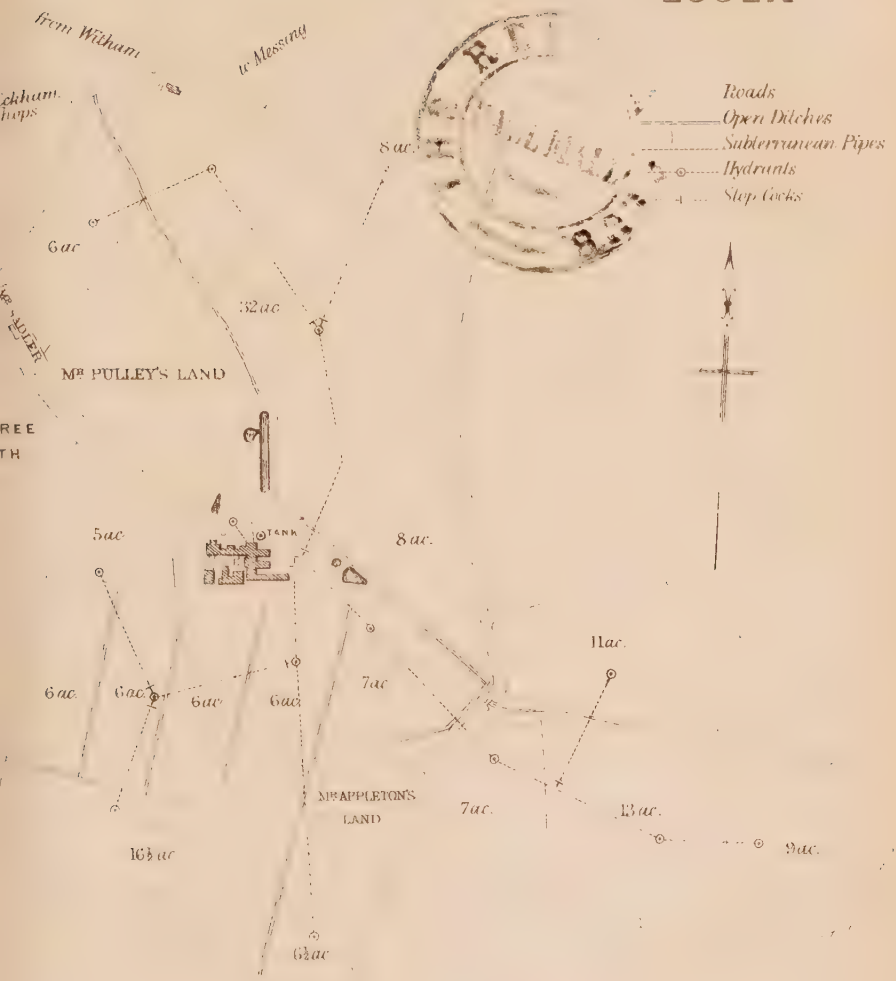
The principle of the plan is soon described. It consists simply of a system of under-ground pipes laid over the farm, into which the liquid manure is forced from a tank either by gravitation, or by pressure from pumps worked by steam or water power; and upon these pipes, at convenient distances, certain valves, hydrants, or junction pieces are fixed, to which a length of flexible hose pipe, with a nozzle, is attached when required for distribution of the liquid over any part of the land.

Such a system of pipes has been for some time laid over Tiptree Farm, and Mr. Mechi has furnished to the public from time to time the valuable results of his experience on this subject. The accompanying plan (No. 4.) of Tiptree Farm is copied from one furnished by Mr. Mechi to Morton's Cyclopædia of Agriculture.

The farm comprises 170 acres, chiefly of arable land, and the pipes are laid so as to command the whole area. A covered circular brick tank capable of holding 80,000 gallons receives all the solid and liquid farm refuse, and it is there diluted by water, in part derived from the drainage of the land, and the whole is kept in agitation by the spare steam from the engine playing through an arrangement of perforated pipes at the bottom of the tank. The engine is of four-horse power. The pipes are all of 3 inches diameter, 50 tons weight in all, and in length 2,550 yards, or 15 yards to the acre.

The following is Mr. Mechi's statement of the cost of the works:—

PLAN
OF
TIPTREE FARM
NEAR KELVEDON
ESSEX



SCALE

24 Chains

	£
Tank - - - - -	100
Engine - - - - -	100
Pumps - - - - -	60
Pipes, laying, and hydrants - -	350
Gutta-percha distributing pipes - -	50
Extra taps, air vessels, and sundry minor arrangements - - - -	60
	£720

or about 4*l.* 5*s.* per imperial acre. The price of iron, however, at the time these works were executed was as low as 5*l.* per ton.

The daily working cost is stated to be—

	s.	*d.*
Coals, at 1*s.* per cwt. - - -	6	0
Man at engine - - - -	1	8
3 boys working two jets, and moving	1	6
1 lad the pipes - - -	1	0
Wear and tear, and repairs - -	2	6
	12	8
7½ per cent. interest on first cost 54*l.* per annum or for 300 days - -	3	7
	16	3

The quantity delivered daily, in ten working hours, would be 130 tons of water, but Mr. Mechi estimates that the cost of delivery may be fairly placed at from 1½*d.* to 2*d.* per ton, "the specific gravity of liquid manure being so much greater than water."

There will be distributed over the whole farm on the average from 45,000 to 50,000 gallons of liquid manure per acre per annum.

Of course, if at any time desirable, the liquid manure of the farm may be applied in a concentrated state, but Mr. Mechi's practice is to dilute it sufficiently to avoid any offensiveness, and certainly on the occasion of my visit, in warm weather, although there was a perceptible smell from the jet, it was by no means powerful, and the land was perfectly free

from any odour of manure within a minute of its application.

At Myer Mill Farm, in Ayrshire, which until recently was rented by Mr. James Kennedy, works for the application of liquid manure have been established for some years, and have been previously described in the Report of the first General Board. The arrangements differ somewhat from those at Tiptree, and especially in the fact that water has to be raised about 70 feet for the purpose of diluting the liquid manure.

The pipes are laid over about 400 imperial acres of very variable soil. The liquid refuse of the farm drains into four separate covered tanks, of a total internal capacity of nearly 45,000 cubic feet, and capable of holding three months' liquid produce of the farm. An agitating apparatus was fixed in each of these, but it has never worked efficiently. A fifth tank, of 20 feet diameter and 15 feet deep, is situated on the high ground at a distance, to which the liquid manure is raised and thence applied to a part of the farm by gravitation.

The pipes are of iron, of 5, 3, and 2 inches in diameter, and upon these, hydrants are placed at intervals for attaching gutta-percha distributing hose. The engine is of 12-horse power, but it is not wholly employed in pumping; all the usual farm machinery is worked by it as well. From 3,000 to 4,000 gallons are pumped from the tanks per hour. The liquid manure had not been applied to the land for three months before my visit, Mr. Kennedy having just vacated the farm; but the agent informed me that it had been the practice to apply from four to six dressings in the course of the year, and about 6,000 gallons per acre at each dressing after cutting. The smell was said to be perceptible for a day or two after application.

Besides the liquid manure produced from about 130 cows and from 1,600 to 1,800 sheep, large quantities of other manure—farm-yard, guano, and ammoniacal liquor,—were applied on the farm. It was the practice to sow the guano, and then wash it in with

the hose. The liquid manure was applied winter and summer.

One man attended to the engine, and a man and a boy to the distribution; their wages were under 2*l.* per week.

I could not obtain any reliable information as to the complete cost of these works, but as there is nothing special in their character the outlay may be presumed to be somewhat similar to that of other ordinary cases, which appears to be on the average about 5*l.* 10*s.* per acre; the range having been hitherto from about 4*l.* 10*s.* to 6*l.* 10*s.* per acre.

The tanks are unusually large, but they were cheaply constructed of stone obtained in the neighbourhood. Iron would be cheaper here than in many other localities, but additional outlay was necessary for raising a supply of water for dilution.

The arrangements at Mr. Robert Harvey's dairy farm, near Glasgow, differ again in some degree from those previously described.

The pipes are here laid to command the distribution of liquid manure over 400 acres of heavy clay land of a hilly character, immediately above the city of Glasgow.

Mr. Harvey possesses an extensive distillery here, and the dairy of about 700 cows appears to have been established with the view to the profitable disposal of the grains, and the farm arrangements are subservient to this establishment.

The works for the application of the liquid manure on the farm were established some years ago in consequence of the complaints of nuisance from its previous discharge into the adjoining canal.

The whole of the liquid refuse from the cow byres, and the waste fluid from the distillery, drain into a tank capable of holding 30,000 or 40,000 gallons, whence it is raised by an engine of 12-horse power, fitted with two 5-inch pumps, into nine circular wooden cisterns or brewer's vats erected above ground on the different high points of the land.

The rising and connecting main to these vats is 4 inches in diameter, and the different systems of

pipes laid over the land from the vats are supplied by gravitation from these centres.

Hydrants are fixed at certain intervals along the pipes, to which, instead of the considerable lengths of flexible hose now more commonly used, moveable iron pipes in three-feet lengths, and of one and a half inches diameter are attached, being joined on to each other as they are successively required for the irrigation of the more distant parts around. The distribution is effected either by shedding from the end of these pipes as they lie on the ground, or by a short length of gutta percha and canvas hose joined to the end of them, and fitted with a nozzle.

The liquid manure appears to be used in a very concentrated form; in fact, at the time of my visit, it was being shed on the land in about the consistency of pea soup, but there was then only a small supply in the tank from which it was delivered. There was an offensive smell from the distribution, as might be expected, and the irrigated land remained in an unpleasant state, the refuse being too thick to be absorbed.

I failed in obtaining any particulars as to expenses of the works or as to produce on this farm. Mr. Harvey was unwilling to afford any information, and he assured me, indeed, that he had kept no records whatever that would enable him at any time to make a correct estimate either of the cost or of the results of this work, distinguished from the other operations of his establishment.

The cows are in great part fed from the distillery.

Mr. Telfer's dairy farm, near the town of Ayr, over which pipes are laid for the application of liquid manure, consists of about 50 imperial acres on a low level, close to the sea, the subsoil being in great part beach gravel. Forty-eight cows are here kept, and the dairy arrangements are a perfect model of neatness and of ingenious contrivances for the health and comfort of the cattle.

The cows lie on cocoa-nut fibre mats. No litter is used, and the solid and liquid excrement of the animals drain together from the byre into a tank outside, which is capable of containing about six

weeks or two months' supply. The liquid from this tank is applied by the hose and jet over the farm ; the solid is allowed to deposit and is mixed with the farm yard manure, and employed in the usual way.

Another liquid manure tank adjoins the one for the reception of the refuse from the byre, from which ammoniacal liquor, phosphates, &c. are also applied by the hose and jet. Both tanks are open.

The liquid is raised from these tanks, and the requisite pressure for distribution given in the pipes by a three-horse engine working two 4-inch pumps. The pipes are of iron, 3 inches diameter, and a length of 150 yards of gutta percha pipe 1½ inches diameter is fixed to the hydrants for distribution. Each hydrant commands about 3 acres.

In addition to its use for irrigation the engine is employed in churning, pumping water, and other farm purposes.

From four to six cuttings of Italian rye grass are obtained, and after each cutting the land is dressed with about one inch depth of liquid manure, say 23,000 gallons per imperial acre. Guano is sown on the land and washed in with the hose.

The system of liquid manuring is considered a most useful auxiliary on the farm, but it does not supersede the employment of manure in the usual way. Large quantities of solid manure are used.

John Daw, Esq., of Exeter, farms about 100 acres of heavy clay land at St. George's Clist, about five miles from that city, and he has had 3-inch pipes laid over 35 acres of drained land, for irrigation with the liquid manure from the cattle sheds and homestead.

The requisite pressure for distribution is given by a water-wheel 17 feet in diameter. The irrigation goes on only for about eight hours, one day in the week on the average, but it is employed most frequently in the winter and in times of rain, for there being no water to spare for dilution, the liquid manure is used in the concentrated form as it drains into the tank.

The tank is capable of holding 100 hogsheads, or 5,400 gallons, which quantity is applied at each working to an acre and a half of land.

There are eight hydrants or junction pieces on the pipes for attaching the distributing hose. The cost of the works, exclusive of the power, which is employed for all other farm purposes, was about 5*l.* per acre.

Distribution of Liquid Sewage.—Although for some years past works of the nature already described have been established on several farms in this country for the application of manure to the lands in the liquid form, it is only recently that works have been established for the application of town sewage in the state in which it drains to the outfall.

From this statement, however, the abandoned works of the Metropolitan Sewage Manure Company, established some eight or nine years ago, must be excepted; and as these works, notwithstanding their abandonment, afford an instructive lesson, it will be useful briefly to refer to them.

The pipes were laid over the market gardens of Fulham, the steam-engine, and stand pipe 75 feet high, being situated at Stanley Bridge, adjoining the Kensington Canal. About 15 miles of pipes were laid down, ranging from 14 to 2 inches in diameter. The sewage was taken from the Walham Green sewer. Hydrants were fixed at convenient points on the pipes, and the tenants of the lands over which they were laid paid a rent to the Company of 3*l.* 10*s.* per acre per annum for the privilege of distributing the sewage themselves whenever they pleased.

Such are the particulars of these works given in the report of the first General Board of Health. I shall have to show, further on, how impossible was a successful commercial result from such an undertaking.

The most important and complete example of works for the distribution of town sewage is that in the neighbourhood of Rugby, where G. H. Walker, Esq., of Newbold Grange, has established the necessary means for applying the sewage of Rugby to his land.

PLAN OF GROUND
UNDER
Irrigation
FROM THE
SEWAGE WORKS
OF
G. H. WALKER, ESQR.
In the Neighbourhood of
RUGBY.

Scale
0 1 2 3 4 5 6 7 8 9 10 15 20 24 30 Chains
100 500 1000 1500 2000 Feet

Complete works for the drainage and water supply of Rugby have been carried out within the last few years under the Public Health Act. The sewage is estimated to proceed from a population of about 7,000, and in quantity it is calculated at about 160,000 gallons per day. All cesspools have been abolished in the town, and even the humblest dwellings have been provided with water-closets, so that the whole of the fœcal refuse is at once removed from the site of the houses, and discharged at the outfall before time has been allowed for its decomposition.

The outfall for the drainage was originally constructed for discharge into the River Avon, and this line still forms the overflow during flood, or when the application of the sewage to the land may from any cause be interrupted; but the outfall for ordinary discharge is now into an open brick reservoir of 50 feet diameter and 12 feet depth, on Mr. Walker's land.

From this reservoir the sewage is forced into the system of cast-iron pipes laid over the farm by a high-pressure steam engine of 12-horse power, fitted with an ordinary 12-inch pump usually worked with a 2-feet stroke. The greatest elevation to which the sewage is pumped is about 60 feet above the reservoir, but a considerable portion of the land is only 20 feet above that level, and some of it is 20 feet below.

The engine works at the same time a small air-pump for the purpose of agitating the sewage in the reservoir, and preventing deposit of the solid matters. An inch and a half gutta-percha pipe extends from the air-pump to the reservoir, where the discharge of air from it keeps up a constant ebullition in any part required.

The pipes are laid over 470 acres of chiefly grass land (plan No. 5), and comprise a length of about 5½ miles, or about 20 yards per acre. They have not been properly graduated in size; the rising main is 6 inches in diameter; and all the branches are of 3 inches.

Upon these pipes, at distances varying according to the requirements of the land, 66 hydrants or junc-

tion pieces are fixed, to which the moveable gutta percha piping is attached from time to time as it is required to distribute the sewage in the neighbourhood of each.

Until recently there were but thirty-nine of these junction pieces, but they were found inconveniently distant. There is even now only one hydrant to about 7½ acres on the average.

Mr. Walker originally employed the usual ball valve hydrants used in waterworks, but he did not find them successful, as the solid matters constantly prevented the close contact of the valve. The hydrant, properly so called, is not now used here at all, but a common flanged junction piece is fitted on the line of pipe, turned up vertically, capped with a simple flat cover, secured with a couple of nuts, with a gutta-percha ring between. The hose is provided with a mouth-piece which is fitted on for use in the place of the cover, when the engine is not at work or when the sewage is shut off.

About 140 yards of 2¾-inch gutta-percha hose is used, to the end of which two lengths, each of 100 yards, of 1½ inch pipe are attached for distribution. The 2¾ pipes are in 20-yard lengths, as many being secured together as are required, by a screw clip. Five or six of these 1½-inch distributing pipes are in constant work. Trial was made of the flexible canvas hose for distribution, but it rotted in a very short time. The gutta-percha pipe remains sound, except where damaged by heat, or by clinking in the cold weather.

The hose is apt to get choked at the junction of the smaller pipes with the 2¾ main length, which occasions some trouble, but this would be corrected by better means for preventing solid substances from reaching the pumps.

These works have cost very nearly 3,000*l.*, or about 6*l.* 7*s.* 0*d.* per acre. With the experience now gained, Mr. Walker considers that complete works might be executed for 5*l.* per acre, and, moreover, looking at the quantity of sewage at command, he would not, in laying down the work de novo, extend the system over so large an area.

About 100,000 gallons, or 446 tons per annum are now on the average distributed on each acre of land at a cost of 20*s.*; that is to say, that the interest on outlay, rent of sewage, coals, labour, and all expenses amount to 1*l.* per acre per annum.

Mr. Walker pays to the Local Board of Health of Rugby, 50*l.* per annum for his lease of the sewage.

The land is not drained. This is proposed to be done very shortly; the soil is, for the most part, of a marly character.

I could perceive no smell whatever, either at the reservoir, or on the land even where thoroughly saturated; scarcely was any discernible even when walking close round by the jets. It was cold weather at the time of my visit; but Mr. Walker assured me that no offensive odour has been at any time perceived on the land, although the irrigation is constantly going on immediately around his own house and that of a neighbour.

No distribution, of course, takes place on the Sunday, and smell at the reservoir is said to be very perceptible on Mondays, the sewage having had so many hours time for decomposition before it is received into the soil.

The distribution has gone on through winter and summer for about 300 days in the year, since the works have been established, with only one interruption during the six weeks frost of 1854, when an action was brought against the Local Board for pollution of the river by discharge of the sewage.

During last winter, 1855, the works were stopped only for two days.

The sewage derived from the very partial drainage of the town of Rusholme, near Manchester, has been applied for the last four years upon the land of Mr. Worsley.

These works were examined by Mr. Dickens, Superintending Inspector, in November 1855.

The quantity delivered at the time of the examination appears to have been about 15,000 gallons per day. It discharged into a tank capable of holding about 24,000 gallons.

The area of land irrigated is about 80 acres.

The sewage is forced into the system of pipes laid in the land by a high pressure engine of 3-horse power, fitted with two pumps of $3\frac{1}{2}$ inches diameter, with 9-inch stroke.

The pipes are partly of iron and partly of wood. The iron pipes are 3 inches in diameter, and the wooden pipes are 2 inches. Between 500 and 600 yards of each kind have been laid. The greatest elevation to which the sewage is forced is only 30 feet; but the wooden pipes, which are mostly of poplar, will not stand the pressure, and they constantly require repair and renewal.

Hydrants are placed at intervals on the pipes, to which the distributing hose of gutta percha, 2 inches in diameter, is attached.

The daily quantity of sewage (15,000 gallons) is distributed over 2 acres in the space of 10 hours.

Reckoning 300 days' distribution this quantity furnishes annually to the land irrigated 56,250 gallons per acre, or little more than half the quantity applied at Rugby.

There was very little smell perceived from the sewage issuing from the pipes, but it was stated by Mr. Worsley's agent, Mr. Taylor, that at times when irrigating the field *in front of the house*, they have been ordered to desist, in consequence of the smell being very apparent there.

These works have cost about 500*l.*, being at the rate of 6*l.* 5*s.* per acre.

Two men and a boy are employed with the engine and the distribution of the sewage, at the respective wages of 15*s.*, 10*s.*, and 6*s.* per week. About a ton and a half of coal, costing on the average 7*s.* per ton, is consumed weekly.

The cost of the application of the sewage, therefore, is said to stand thus:—

Wages and coals per annum - - - -	£107	18	0
Interest and depreciation on 500*l.* at $7\frac{1}{2}$ per cent -	37	10	0
	£145	8	8

or about 1*l.* 16*s.* 4*d.* per acre per annum.

Mr. Taylor appears to have expressed himself well satisfied with the effects of this sewage irrigation, and obligingly promised to furnish the result of some careful experiments he was about to undertake as to the relative productiveness of land manured with the sewage and of that manured in the ordinary way, and as to the quality of the produce of each in reference to the fattening of stock.

These works are interesting as an example of how small a place it may be worth while, as a profitable investment, to lay down pipes upon, and even to erect engine-power for the purpose of getting this manure on to the land. The quantity of sewage delivered at the outfall was equal only to the ordinary discharge from 150 houses.

About ten acres of land near the Craigentinny meadows at Edinburgh, but closer to the city, have had pipes laid down for about three years, for the distribution of sewage from the Foul Burn, which is raised for the purpose by a small water-wheel.

I was not able to obtain any detailed particulars of this case, and it is scarcely worth mentioning, except for its smallness and for the enormous produce of Italian rye grass which is said to have been obtained from it.

The town of Watford having been drained and supplied with water under the Public Health Act, the Earl of Essex has entered into a contract with the Local Board of Health to take the sewage upon lease, with the view to its application to the neighbouring lands in the liquid state.

His Lordship has agreed to pay 15*l.* per annum for the use of the sewage for a term of fourteen years, and he conveys to the Local Board the freehold of the site of the reservoirs erected by them, and pays 5 per cent. on the cost of construction of these works.

They have been completed for some time. An engine has been erected, and cast-iron pipes of 5, 4, and 3 inches diameter have been laid over 200 acres

of land; but various causes appear to have delayed the regular application of the sewage to the land.

Pipes have also been laid by the Earl of Essex over about 40 acres of the Home Park of Cashiobury, by which the liquid manure of the farm has been distributed for the last three years.

In addition to the arrangements for the manufacture of solid sewage manure at Dartmoor Prison already described, the liquid drainage from the establishment is raised by hydraulic engine, (with a pressure on the cylinder of from 20 to 25 lbs. on the inch,) for application to the land.

The buildings are drained by 6-inch earthenware pipes, into an arched cesspool, whence the liquid portion of the sewage is pumped through 2-inch cast-iron pipes into a tank, 13 feet by 7 feet 6 inches and 5 feet 6 inches deep. This tank is situated at the highest point of the fields, about 280 feet above the level of the cesspool, and at a distance of 34 chains.

From this tank two others of the same size are supplied by 2-inch connecting pipes, the quantities being regulated from one to the other by sluice valves. Each of these tanks is furnished with a 2-inch cast-iron outlet with sluice valve, to which 2-inch canvas hose, in 40-yard lengths, with brass couplings, was formerly connected for the distribution of the sewage to the surrounding land; but as the hose was found to decay very soon, the liquid has for some time been conveyed to the different parts required by small channels cut in the land, regulated merely by stopping, where necessary, with a sod.

The liquid is applied to grass lands and green crops with remarkable results; but the dry manure is principally used here, being considered more suitable to the land, which is naturally of a damp nature.

The level of Dartmoor Prison is 1,400 or 1,500 feet above the sea.

Works have been constructed at the Colney Hatch Lunatic Asylum, and pipes laid on the neighbouring land for the distribution of the sewage of the esta-

blishment by hose and jet, but the works not being complete, I have not yet had an opportunity of inspecting the operations at this place.

Agricultural Results from the Use of Sewage Manure.

When we look at the enormous value, in the aggregate, of the sewage refuse of our towns,—the metropolis alone producing 140 tons daily of dry manure, of which upwards of 20 per cent is said to be ammonia,—it appears strange at first sight that at a time of great excitement and anxiety as to foreign supplies, so little attention should be given to this great store of fertilizing matter at home; but I believe that little examination is necessary to show that this is a very natural consequence of the present state of the question.

So many contradictions and discrepancies are encountered in the experience of the use of sewage as manure, that I should hesitate to offer any observations on the results of its application, were there not the strongest evidence offered to common sense of the causes of those contradictions.

It would be beyond the province of this report, even if I felt competent to the task, to enter into any comparison of sewage with other manures, or of the advantages of its application in the liquid, over those of its application in the solid form. Unless some standard be used, I am at a loss to know how these comparisons can be made. Nothing has impressed me more strongly, during my inquiries, than the loose but decided manner in which sewage and other liquid manures are frequently spoken of as one and the same thing, of a fixed value, from which the same results may be expected, whatever fertilizing elements they may contain or whatever their amount of dilution.

The analyses conducted by chemical authorities have satisfied them that all the elements required for

the food of plants are contained in the sewage of towns, and therefore that, like farmyard manure, it is of value for general application. It is most important to see by what means that value has been hitherto best realized, or what promise there is of attaining better general results, and of removing objections to its use by the employment of improved methods of application.

Chemical examinations of some of the patent solid sewage manures show that they contain certain elements of value as fertilizers; but although some of these have been in use for several years, there appears to be no distinct evidence yet of decided agricultural results. True, large quantities have been sold, even at high prices; but I am afraid that this cannot be admitted as evidence of value.

The slowness of the agricultural mind to depart from old practices, or to receive new doctrines, is often alluded to in explanation of the little progress that has been made in the utilization of sewage. My short experience on the question by no means supports this conclusion. Whether or not the old school of farmers may be open to the allegation, a race of men are now found taking the lead in the agricultural affairs of the country, anxious above all things for progress and improvement, and the very fact that manures will constantly find buyers for the purposes of trial, at 3*l*., 5*l*., and even 10*l*. per ton, without satisfactory guarantee that they are worth as many shillings, would suggest rather too great eagerness than any slowness in the trial of new things.

Various analyses of solid manure, manufactured by the lime process from sewage of very different quality in the liquid state, are so far similar as apparently to confirm the statement that very little of the more valuable ingredients is arrested by that method; nor, although this manure has now been in the market for at least eight years, does there appear to be any authentic record of decided increase of fertilization from its use.

Among the analyses of solid sewage manure which show a greater value, Mr. Herapath's, of sewage manure made under his patent, and Dr. Penny's, of

manure obtained by Mr. Manning's process are entltied to consideration. Mr. Herapath fixes a price of 3*l.* per ton for manure manufactured by his process; Mr. Manning estimates the value of his manure, according to Dr. Penny's analysis, at upwards of 2*l.* per ton. I do not presume to offer an opinion upon these prices, but no results are yet known from the use of these manures. Mr. Manning states that he has taken measures to ensure trial on a large scale, by dressing land with quantities varying from one to three tons per acre.

The examination of the solid sewage manure of Cheltenham shows a low value, as might be expected, but one sufficiently near the value of manures obtained by the lime process, as apparently not to justify the adoption of the expensive apparatus involved in the latter manufacture.

The agricultural results obtained at Cheltenham warrant the conclusion that, sold at a price which will cover the cost of manufacture, this manure will always be in demand for local use—but for *local use only*, as the expense of transport to a distance would soon run away with its entire value, and even render it costly at a gift.

In the absence of repeated and watchful trial, it is, for obvious reasons, impossible to determine the precise value of a manure. One manure may show good results immediately, but may have an exhausting tendency; another may produce but little result on a first crop, reserving its effects, as it were, for a second, when its value may be ascribed to some subsequent, and perhaps worthless addition; but, so far as can be judged from a single trial, the results from the use of the Cheltenham sewage were very satisfactory.

Two tons of hay were obtained where previously not one ton had grown; the grass much finer than before, and clover abundantly springing up. Mangel wurzel was grown of 35 and 36 lbs. weight, where previously it had attained only from 16 lbs. to 18 lbs. Immense quantities of the manure, however, were applied—too much for economy; and probably good effects may be traced from this first application in

subsequent produce; but being a manure of low value, large results could not reasonably be expected from small quantities. On grass lands 20 and 25 cubic yards per acre were applied,—the latter admittedly an overdose; but quantities may be lavishly used at 3*s.* or 4*s.* per ton, that would be utterly ruinous at 2*l.* or 3*l.* for manure of little additional value. All the evidence leads me to doubt whether marked benefit will be found from the use of one, or even three, tons per acre of any solid sewage manure yet made, so far as its value has been derived from sewage.

The Cheltenham manure was used upon heavy land, and the ashes themselves would, in such case, be of lasting benefit. For use upon light land, it may be preferable to prepare the solid manure with clay as the deodorizer, as at Ely, when it can be obtained immediately on the spot; and, in some cases, no doubt, charcoal, lime, gypsum, and other ingredients will recommend themselves.

With respect to results derived from the application of liquid farm manures, although much evidence has been offered on the subject, I have scarcely found in any case that those results could be considered as wholly due to such mode of application, both solid and liquid manures having been, for the most part, used more or less on the same land.

But even where liquid alone has been applied, it proves absolutely nothing in favour of the application of liquid *sewage* to show that certain remarkable results were obtained from the use of liquid *farm manure* of any desirable quality and strength.

Upon one point, however, the evidence as to the application of liquid manures on farms is most satisfactory; as showing, namely, that the laying down of distributing apparatus for the purpose is of itself an excellent investment, from the facility thereby afforded for conveying manures cheaply to the land whenever or wherever required, or for washing in solid manures. This experience is wholly irrespective of the advan-

tage of the application of sewage; but it has an important relation to it as lessening the risk which might otherwise be run, of providing expensive apparatus usefully applicable to this purpose alone.

With respect to the advantages to be derived from the application of liquid town-sewage to agriculture, there is no subject, probably, as to which a greater difference of opinion prevails,—a difference which seems to be accounted for by the very various results of its application.

On the one hand it is stated, that the use of sewage encourages the growth of weeds and of rank and inferior grasses; makes coarse hay; renders the land unsuitable for cattle, dangerous for sheep; and kills the grass in winter.

On the other hand it is alleged, that where liquid town-sewage is applied, fine grasses and white clover, never seen before, spring up; that animals do not suffer, and much prefer the grass last irrigated; that luxuriance of growth is much encouraged by the previous winter's application.

These opposite experiences may all be verified, and appear to be solely due to difference of treatment.

Similar variety will be found in the actual amount of produce obtained, and in the increase of the value of land from the use of liquid sewage.

The land at Crediton, irrigated with the sewage of that town for years, lets in small parcels at about 7*l.* per acre, while good grass land in the neighbourhood, not capable of irrigation, is said to be worth 5*l.* or 6*l.* per acre. The grass of these irrigated fields is both rank and coarse, and the hay of inferior description. The land is very wet and swampy, and cannot be stocked with sheep or cattle so early in the spring or so late in the autumn as other meadows.

The rental of the meadows of Tavistock referred to, varied from 15*s.* to 2*l.* per acre before the sewage irrigation; they are said to be now worth from 2*l.* to 5*l.* per acre. This difference Mr. Benson, the Duke of Bedford's steward, conceives to be due to the irrigation, but considers that were it well attended

to, the value would be "vastly increased." The grass was very coarse here at the time of my visit, and the meadows were looking in very ill condition.

At Harrow the value of the land is admittedly increased by the sewage irrigation, but this increase is not stated as of any amount, and the hay is said to be of coarse quality.

Of the instances in which underground pipes have been established for the application of sewage, that of the Metropolitan Sewage Manure Company was, commercially, a complete failure. No other result was possible. Considerable works, of the most expensive kind, were constructed for distributing liquid very nearly worthless as manure over a district already in possession of the greatest facilities for obtaining the valuable stable manure of the Metropolis at the most economical rate, by means of the return carts which convey to London the produce of the market gardens, and which would otherwise return empty. In fact, practically, this was little more than a company for supplying the market gardens of Fulham with water during periods of drought; and, although, no doubt, a beneficial service, it will readily be imagined that the saving of labour of hand-watering over a limited district of garden ground would produce no adequate return for so costly an establishment.

The Rugby works, although successful, can only be pronounced so in a limited degree as an investment. The results of the application of the sewage, as there conducted, appear to warrant an estimate that the value of the land is permanently increased by the works to the extent of 1*l.* per acre.

I have reason to believe that these accounts and statements represent the *usual* increase of value of land from the application of the sewage of towns, and the agricultural objections to its use as ordinarily applied.

Let us now turn to the Craigentinny meadows. Part of this land, formerly almost worthless, is now let at from 9*l.* to 11*l.* per Scotch acre; the average rental of the meadows is said to be 20*l.* per acre; the last highest letting before my visit was very nearly 40*l.* per acre.

From what cause does this enormous difference of value arise? Simply from the fact, that in the latter case, the continuous application of the sewage is reduced to a system, by which immense quantities of manure are judiciously put upon the land; while in the other cases, very inadequate quantities are injudiciously given, by intermittent application without system.

There is nothing special in the Edinburgh case beyond this, and the mode of disposal of the produce. The ordinary sewage of a mixed population is there distributed in enormous bodies of water over land of various quality, light and heavy; and that portion of the land which was naturally not well suited for the reception of such large quantities of liquid, was rendered so by artificial drainage.

There can be no reason why, by similar methods, judiciously applied, similar results may not in most cases be produced, wherever liquid sewage is at command.

It should be borne in mind, that it is from grass only, cut for stall-feeding, that this extraordinary value is obtained. The meadows are let in small lots every season (extending from April to October), to the cowkeepers of Edinburgh, who obtain four and five cuttings during that period, amounting in weight, in some instances, it is said, to eighty tons per acre.

The whole area is laid out in divisions for watering, which proceeds successively throughout the year; so that when the whole of the divisions have been served, the irrigation is commenced again with the first. The same course of irrigation goes on through the winter, and if any portion of the land has not done so well the previous season, it is treated in the winter time with a larger quantity of the sewage than usual, invariably with marked improvement. The limit of production has not yet been reached; *the more water each portion of the land receives, the larger is the crop produced.*

Such being the extraordinary results of a system practised for so many years, does it not naturally suggest itself in seeking the means of disposing of town-sewage generally to the best advantage, that

they should be such as to allow of the application of the whole quantity upon a minimum space on which the vegetation can assimilate it without waste, rather than upon a wider area, at an increase of cost and with a decrease of fertility?

Evidence is afforded, in other places, of remarkable effects of sewage applied to cereal, and especially to root crops. Mr. Walker has grown wheat for three years in succession on the same ground with no other manure than the liquid sewage, with perceptibly increased results; but I regard all such evidence as unimportant, for at the best there can be but a very small consumption of sewage in this way.

Let me add a few words as to the agricultural objections to sewage irrigation to which I have already alluded.

"It produces coarse inferior hay." If so, why make it? No hay is made on the Edinburgh meadows. Opportunities exist in that case for disposing of the produce in a green state. Similar opportunities exist more or less in every town.

"It encourages the growth of weeds and the ranker grasses." But may not this arise from the very fact of extending the period of growth for the purposes of hay, when the ranker vegetation usurps the ground and overpowers the finer and sweeter grasses? Such has been my impression from observing, where hay has been made, the land covered with dandelions and the coarsest grasses, while in other cases, where the crop has been kept close by frequent cutting, the grosser vegetation seems to have been kept under, and the finer grasses to have had fair play. I find no complaints of the coarseness of hay made on the lands irrigated with the sewage of Milan; but there the climate admits of three crops of hay being made in as many months, June, July, and August; and they are fed off once, and mown four times in the year besides. But again, has the selection of the grasses, for which such irrigation is especially applicable, yet received that attention which the importance of the subject demands? With the exception

of Italian ryegrass, I apprehend not. Benefit may probably arise from consideration of this point.

With respect to hay-making from grass thus grown, I will venture to intrude a suggestion, even at the risk of its being considered beyond my province. In the *Agricultural Gazette* of last year, an account was given of some successful trials in the artificial drying of grass. The proposition there made was to provide a large barn, on the floor of which the grass would be strewn and turned, in a warmed atmosphere. The calculations founded on the trials showed a promising return, but I apprehend that the main objection to the general adoption of the plan would be the first cost of the building for conducting the operation. Might not an apparatus for this purpose be added to the many ingenious machines that have of late years come to the aid of the agriculturist? A wooden or other enclosure, through which a current of dry and heated air should continuously pass, as already employed for the desiccation of other materials; to which current, revolving hay rakes would continuously expose the grass in its passage? The spare heat from the steam-engine furnace might be made partly available.

It would be a great boon to agriculture if some means could be adopted for making hay, whether the sun would shine or not, whenever grass would grow. Not only would much larger quantities be produced, but from the very frequency of cutting would it not consist of finer and sweeter grass? And might not the same or similar apparatus, be made available for artificially drying grain in unfavourable harvest time?

To return to the objections to sewage irrigation. "Cattle will poach the land; sheep will be exposed to disease." If so, why place them upon such land? None are ever seen on the Craigentinny meadows. Keep them on higher and safer ground. Devote the lower levels to the work for which they are most suitable. "Few water meadows," Mr. Pusey says, "are safe to feed sheep upon in autumn."

"Irrigation with sewage in winter time injures or destroys the grass." It may certainly happen with sewage as with other manures, that plants which have

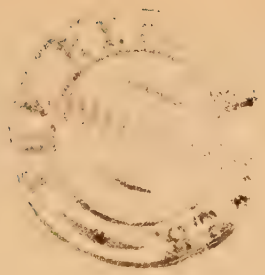
been stimulated during mild winter weather, and are looking luxuriant and well, may be more liable to be subsequently cut off and destroyed by severe frost; and yet the irrigation goes on with sewage and with liquid farm manures alike throughout the winter in all the places recited, with nothing but good result, as far as I could learn; and it was a very general opinion that even in the most exposed positions the vegetation would always be preserved from this danger by keeping a good head to it as protection to the roots.

The agricultural objections to sewage irrigation, properly conducted, do not seem to be formidable. The more serious and valid objections, made on sanitary grounds, to the system as practised at Edinburgh, will, I trust, be entirely obviated by the modifications of practice which I presume to recommend.

Recommendations.

Upon consideration of the facts which I have now been enabled to submit, it will at once be evident that the best means of deodorizing and dealing with the sewage of towns demands much further investigation than has yet been made of the subject; but it will probably at the same time be gathered from the experience so far obtained that by certain processes and admixtures the main object of this inquiry may be in great part at once secured; that is to say, that much of the offensiveness of the sewage of towns may be removed, and therefore much pollution of the rivers and streams of the country avoided; that a solid manure of a certain low value may be obtained by these processes, which under certain conditions will probably pay for the outlay; and that on sanitary grounds, therefore, the adoption of some such process by Local Boards, wherever the Public Health Act is applied, or by the local authorities of the towns where it is not, ought to be insisted upon, wherever an offensive outfall exists, whether arising from new works of drainage or from old.

It would appear that various patent processes are adequate to this partial dealing with the subject; but while the arrangements or materials adopted in those



PROPOSED SEWAGE WORKS.

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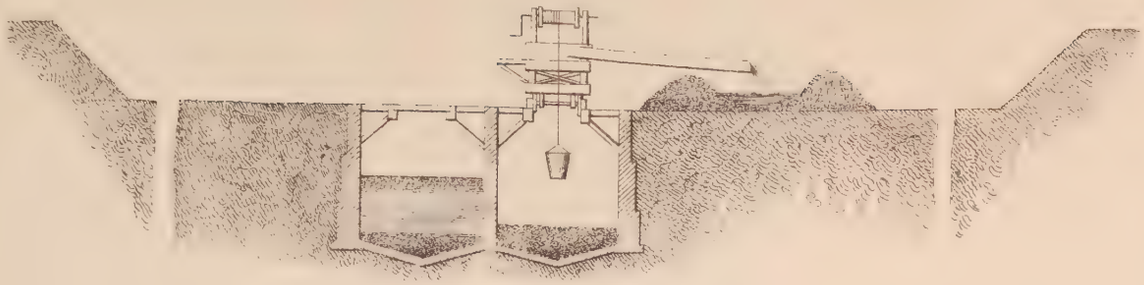

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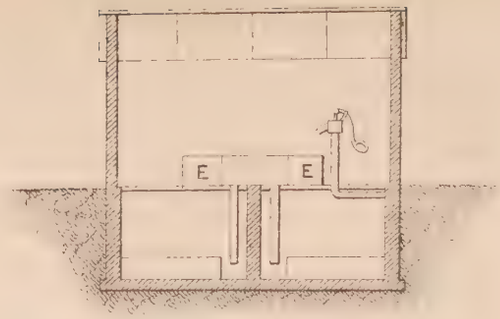

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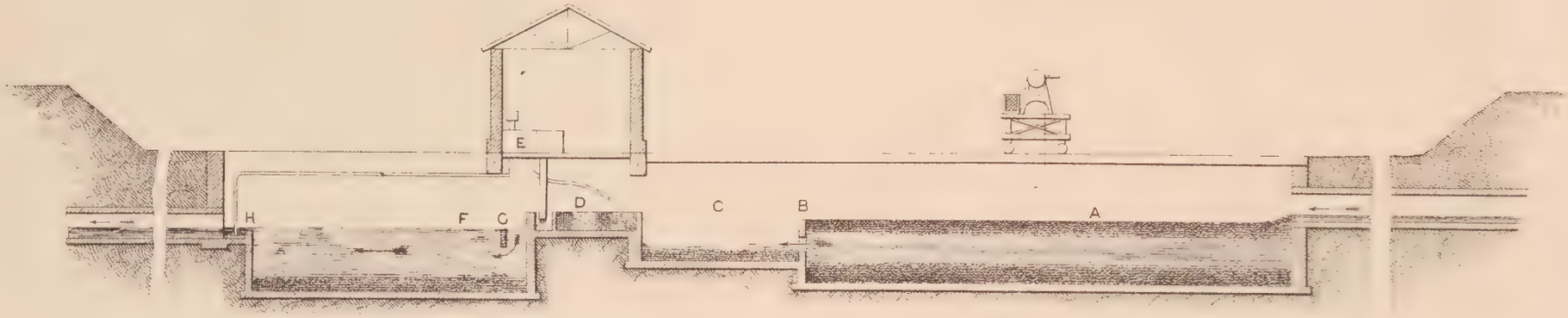
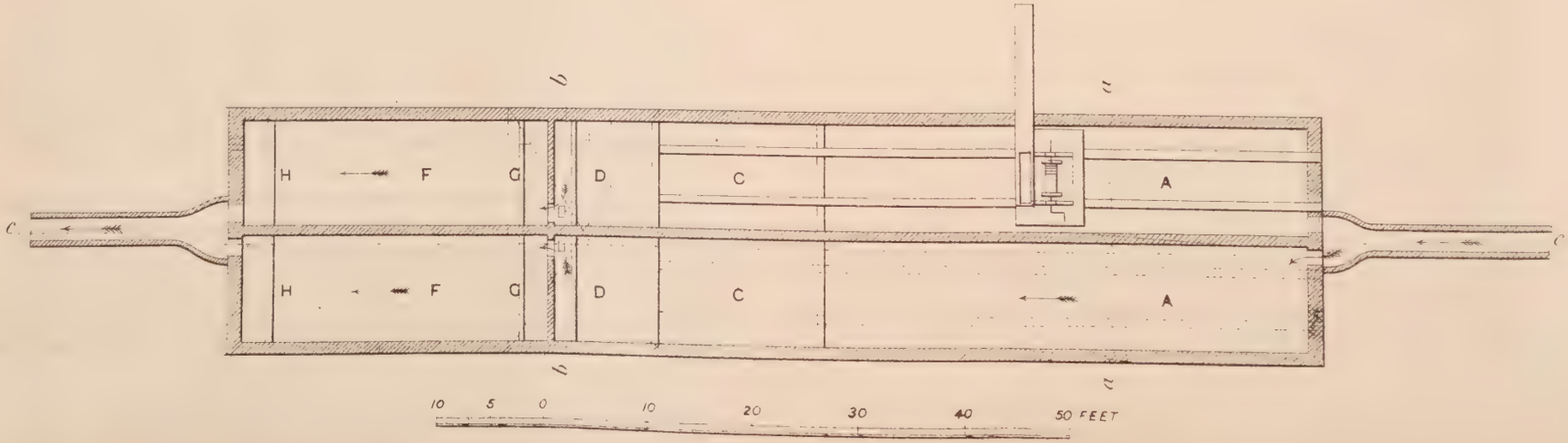




which have been brought into practical operation are for the most part expensive, there is no evidence of their having realized any better results than have been obtained by the simple and economical method adopted with the same object in the town of Cheltenham. Such methods, unfettered by patents or other difficulties, appear to come strictly within the duty of the local body charged with the disposal of the refuse of a town, being, in fact, little more than a transference to the outfall, of duties which they are already bound to perform, namely, the removal from the separate houses of the contents of the midden or cesspool and dustbin.

In proposing, however, for general adoption, some such arrangement for separating the solid portion of sewage from the water in which it is conveyed,—as the first step towards the removal of that pressing evil, the poisoning of the rivers and streams throughout the country,—I desire to submit for consideration certain modifications in the plan, with a view to the more efficient and economical working of the process. These may perhaps be of service for the guidance of local bodies, more especially in towns of the smaller class, where any saving in the cost of works, or in current working expenses, is a material object.

The great bulk of the solid matter, when the sewage comes to comparative rest in the reservoir, divides itself into two bodies; the heavier particles at once deposit themselves at the bottom, and the lighter portions collect, in a solid floating mass, on the surface. It appears to me that the chief proportion of these matters may be intercepted in the first tank A, (Drawing No. 6) both above and below, without a filter, by a simple division, B, with basket-work and perforated boards in the middle, allowing the water to pass through only at a certain depth beneath the surface.

The second tank or reservoir, C, need not then be so deep or so large as the first. At the end of it, filtering materials of different kinds should be arranged, through which the sewage would pass laterally; 1st, coarse screened gravel, beach, or broken stones; 2nd, gravel of medium coarseness; and, 3rd, some finer

material. And there would be much advantage in having this filter, D, shallow and broad, rather than deep and narrow; the surface-water only would pass away, and thus allow of further deposit from the main body before filtration; it would be subject to greater friction and disengagement of the solid matter and foul gases; and the filtering medium itself would be less readily clogged, and would be more accessible for cleansing without removal, as it could be turned over in its place and subjected to complete washing, from a water tank, E, above, as often as desired. A very small area of filter so placed would be found sufficient for all practical purposes.

By some such arrangement also as is shown in the accompanying general plan (No. 7), the work may be brought more compactly together, and the scavengers' carts may deposit the ashes on the spot where they are wanted, and where they may be at once formed into continuous banks for the reception of the sewage deposit, which would be hoisted in the buckets and discharged by a shoot into the midst. Much labour in filling, wheeling, and mixing would be thus saved, and much exposure also of the sewage, which at certain times must be as offensive to the smell as it will always be to the sight, where such an operation is openly conducted.

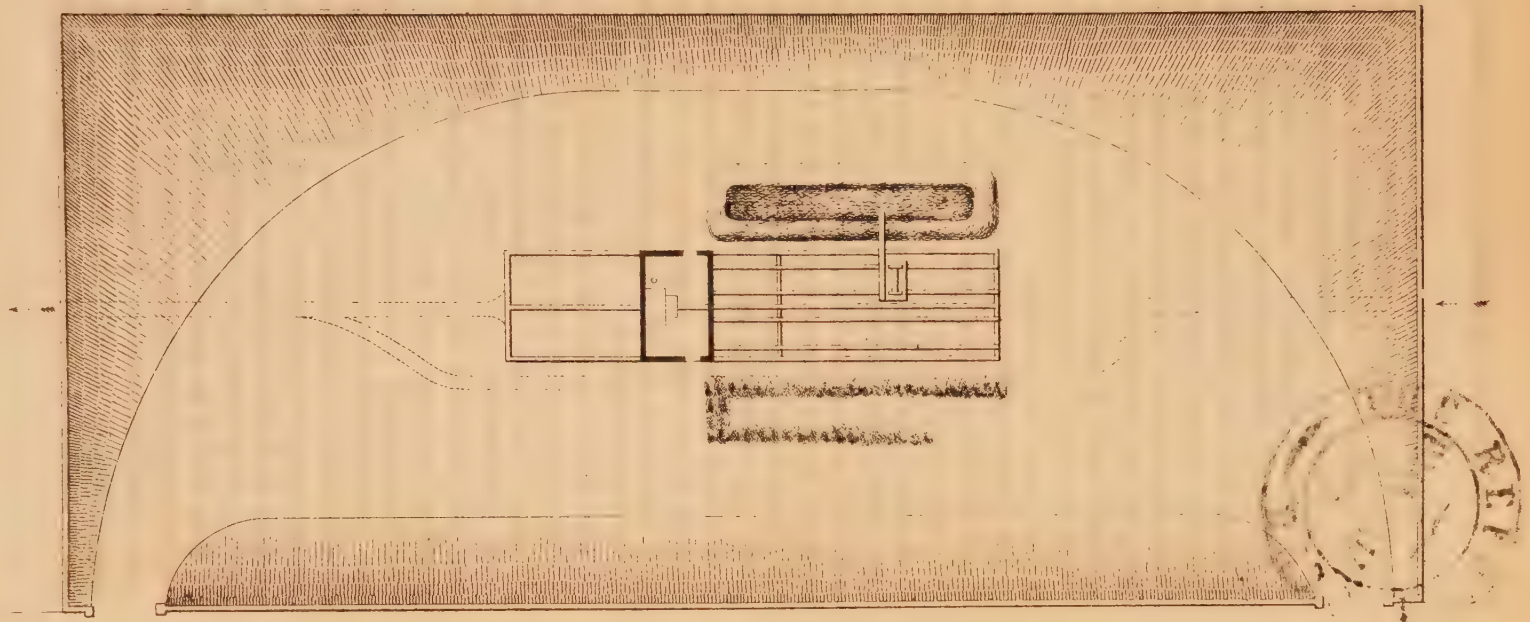
The same necessity for a covering shed over the filters will then no longer exist, and it may safely be dispensed with, provided that the premises are enclosed with a boundary fence, or wall. A small shed only will be required for the liming process, and for housing apparatus and tools.

The reservoir for deposition after the addition of the lime should be considerably larger than that at Cheltenham. There is not time, in that case, for the precipitation to take place. The lime and remaining sewage flow off in suspension to the stream, and have an unsightly effect, if no other inconvenience.

It is stated as one of the results of the Manchester experiments, that the lime falls at the rate of an inch and a half per minute. The admixture being made as the sewage flows into the reservoir at each side, I propose that it should be intercepted by a fender,

PROPOSED SEWAGE WORKS.

General Plan.



Scale of Feet

10 0 10 20 30 40 50 100

that it may not disturb the main body of water, and that the discharge to the outfall should take place over a weir, allowing only a surface film of the water, from which the lime has descended, to pass over.

The depth of this surface water passing over, and the length of the reservoir, must be of course determined by the quantity which has to be discharged.

The construction shown on the plans would be sufficient for a town of about 3,000 inhabitants, and would probably cost from 250*l.* to 300*l.*, exclusive of the excavation of the site and the fencing shown, which would depend upon locality.

The problem, however, of the proper dealing with the sewage of towns is but partially solved by any such process.

If it be granted that the *sanitary* requirements of the question are thus practically satisfied, and that the further decomposition of the remaining elements in solution in the effluent water would be too slight for mischief (a question that demands strict chemical investigation,) all the evidence goes to show that the *agricultural* problem would still be far from settled. The water is robbed but of little fertilizing power by the removal of the solid matter. It will still contain in solution all the most valuable properties, and these, in the present state of knowledge on the subject, can practically only be made available by the application of the water itself to the land.

In some towns, the circumstances of the surrounding district forbid this application, and it will be a subject for further inquiry, whether in such cases the water flowing off should be subject to more complete deodorization than can be accomplished by the above process. But in the majority of cases there is no insurmountable impediment to this application of the liquid sewage, and the evidence clearly points out *that if only proper means be adopted for this application, and for disposal of the produce,* very great advantages may be expected from its use.

Trué, those results are in some degree speculative, and it is not meet for local governing bodies to engage in speculations, however promising their nature; but if

general facilities are only granted by the Legislature for carrying out the necessary works, the speculation will as certainly recommend itself to proprietors or to local companies or contractors as the more ordinary local investments, such as gas and water works. In the present state of agriculture in this country, the means of realizing this object are assuredly most worthy of the attention of Parliament.

The best consideration, however, which I have been enabled to give to the subject, satisfies me that the *large* results promised are not to be obtained by the process employed for the application of liquid farm manures, and for that of the sewage of Rugby and other places; namely, the hose and jet. A certain result will, no doubt, be attained by this method of distributing sewage, which, under favourable circumstances, as at Rugby, will give an excellent return for the outlay; but there will be many exceptions to these favourable conditions. In a great number of places, and for a large portion of the year, the sewage itself will be presented in a far greater state of dilution than it is at Rugby; and were it not so, in no places, and under no circumstances, will the *great* results for years obtained at Edinburgh from the application of liquid sewage, be realized by use of the hose and jet. *The immense quantity required for success cannot by such means be economically got on to the land.*

This expensive and limited mode of pipe distribution answers admirably, no doubt, for the application of the comparatively valuable liquid farm manures, and for the application of sewage to root and grain crops,—or in its least diluted form, in comparatively small quantities, to higher levels of land,—the hose and jet may be usefully employed; but it is not in this way that the greatest benefits from the application of sewage can be realized.

One comparison of present experience will suffice to show how inadequate such modes must be to deal with the enormous quantity in which sewage, to be valuable, must be applied.

Mr. Mechi considers that the cost of delivery of his liquid manure may be fairly estimated at from

$1\frac{1}{2}d.$ to $2d.$ per ton, and he is very well satisfied with his results at this cost. But $1\frac{3}{4}d.$ represents just about the value of the excrements in a ton of sewage, allowing 30 gallons of water per head per day, so that at this cost of distribution every particle of value of the manure which it is at present safe to calculate upon, would be absorbed in getting it on to the land.

According to Mr. Walker's figures, the cost of delivery of the sewage of Rugby on to his land is little more than $\frac{1}{2}d.$ per ton, exclusive of the portion of the rainfall applied. Even this cost, however, must be very materially reduced, for there would otherwise be little value left in the sewage of some places. I shall hope to show that this may be accomplished by the modifications proposed.

The quantity of sewage which may be most profitably applied to land, can only be determined by experience under the many conditions which will modify the practice; but judging from the experience at Edinburgh, I arrive at the conclusion that the sewage of Rugby might have been most advantageously applied to one-fourth or one-fifth of the land over which it is now distributed. Fully that proportion of the area lies conveniently on the low level, so that little or no pumping power would have been required. The saving in original outlay and in the annual working expenses would be the first advantage gained. Without framing any estimate of this reduced work for comparison with the actual expenses incurred by Mr. Walker, which from various circumstances were greater than necessary, the large economy that would be obtained in the main items of outlay,—engine power, pipage, distributing hose, current expenses and superintendence,—is obvious. The next, and far greater consideration, however,—if the produce now obtained from the 470 acres can be grown on so much less an area,—is the saving of that quantity of the land for other cultivation, and of all usual annual expenses attaching to such land.

As to the necessary works for getting the required quantity of manure on to the land, the plan which appears to me best adapted for accomplishing this,

and at the same time for avoiding the sanitary objections to a system of open irrigation as practised at Edinburgh, is to apply the liquid sewage, *after separation of the solid matters*, by a combination of underground mains with Bickford's system of contour gutters.

The quantity which could by this method be delivered at a certain spot, and distributed over a given area, would be limited only by the size of the pipes and the pressure applied therein by gravitation or by engine power. By opening valves placed at convenient points, the pipes would deliver into small troughs, whence the sewage would discharge into the top gutters, and thence into cross feeders as required; and with the same sized mains, one lad would superintend the distribution of many times the quantity that it is practicable to get on to the land by means of the usual small subsidiary pipes and the hose and jet.

In reply to any objections that may be raised, on sanitary grounds, to irrigation with these large quantities of sewage water, it must premised that all land so irrigated ought, as a matter of course, to be sufficiently drained, unless the soil be of a very absorbent nature, so that no stagnant or superfluous water can remain. Unless this can be secured, malaria can hardly fail to follow; but I must repeat that the well-founded complaints at Edinburgh arise from the great extent of evaporating surface in the ditches. In the plan proposed, there will be no ditches; no land either wastefully or mischievously occupied; no stagnant surface of water; no foul deposit.

The main pipes will be the substitutes for the large Edinburgh ditches; the solid matter will be separated before irrigation, and the liquid will be absorbed by the earth, Nature's great deodorizer, as fast as it is exposed.

As an example of the laying out of a farm for the application of the liquid sewage of a town (of, say, 20,000 inhabitants,) upon this principle, I submit the accompanying plan (No. 8.) and estimate.

The land selected for the illustration is an unfavourable example with respect to cost, as the whole of the sewage would have to be pumped and dis-

PLAN OF PROPOSED
SEWAGE IRRIGATION WORKS.

Scale of Feet

700 600 0 500 1000 1400

Day & Son Lith.rs to the Queen

tributed all in one direction from the outfall. In order to make it an extreme case also in other respects, I have preferred to confine the area to be irrigated with the sewage from this amount of population to about 260 acres, although at a very trifling increase of cost, a considerable additional space westward might be irrigated from the same main.

I have estimated that the total quantity of sewage to be applied will be equal to 50 gallons per head per day, although the works proposed would be adequate to the delivery of much larger quantities during the time of the heavier rainfall, which, as I have previously stated, ought to be provided for.

The pressure will be maintained by iron mains, rising to the highest point of the land, but the carriers leading off from the mains, if properly laid out and worked, would not for the most part have to resist any pressure, and might consequently consist of stoneware or strong earthenware socketed pipes with cemented joints.

The works would comprise a reservoir at the lowest and the highest points for regulating the discharge and delivery and for receiving the ordinary sewage of Sunday, a pair of 12-horse high-pressure engines with pumps, &c. complete, 12 and 9 inch iron mains, and stoneware carriers varying from 12 to 4 inches diameter. The carriers would deliver into shallow troughs placed at the highest point of each division for irrigation, and from these the open contour gutters and cross-feeders would extend in each desired direction.

I estimate that these works would cost from 3,000*l.* to 4,000*l.* according to the locality in which they might be constructed, the average being 13*l.* 10*s.* per acre. Interest on this amount and working expenses I estimate at 600*l.* per annum, being 2*l.* 6*s.* 2*d.* per acre.

Calculating upon 280 working days in the year, (and including the sewage of Sunday, which would be distributed on Monday, but omitting the increase of quantity on days of heavy rainfall,) between 5,000 and 6,000 tons per day would be delivered on to the land, or about 12 tons for one penny.

In a case, however, in which the whole quantity could be delivered by gravitation, and in which the outfall would be favourably placed for sending the sewage in different directions, the cost of the works would be about one third less, and the annual expenses including interest on the less outlay, about 300*l.* per annum, or one half of the above, in which case 24 tons of sewage would be delivered on to the land for 1*d.* Taking the mean of these two extremes, the interest and working expenses of the system will amount to 6*d.* per head of the population per annum.

True, that reckoning the cost of this work per acre, it amounts to more than double that which has hitherto been incurred for the underground pipe system; but the only correct criterion of the economy of the work is the cost at which a certain quantity of manure in the sewage can be put on to the land; and it will be seen that that economy is upwards of 4 to 1 in favour of the examples given when compared with the Rugby case.

The quantity of manure proposed to be applied per acre in this example would, no doubt, by many persons be considered excessive, although the quantity of liquid in which it would be conveyed to the land, falls short of the ordinary amount distributed over the Craigentinny meadows. I presume it would be wasteful to apply such an amount of fertilising matter upon some lands, but on others again, even larger quantities might probably be advantageously distributed. As before stated, the proper rule would appear to be in each case, the maximum quantity which the vegetation can assimilate without waste.

Conclusions.

As the result of my inquiries, and of the best attention which I have been enabled to afford to this important subject, I beg to submit the following conclusions:—

1. That although from the earliest agitation of the question of sanitary reform and of the complete drainage of towns, the mischief from pollution of

rivers on the one hand, and the waste of valuable manure on the other, by the direct discharge of the sewage, was insisted upon, no conception was at any time formed of the *extent* of the evil which now so imperatively calls for remedy.

2. That although the means of remedy by deodorization appear to be as yet but imperfectly understood, and demand further investigation, various processes have for a long time been in more or less successful use for this purpose. That the employment of some of these, known to be destructive of the fertilizing power of sewage, would involve expense without any return; and although such expense, if unavoidable, should unhesitatingly be incurred to avoid any permanent danger to the population, it appears that other deodorizing materials are not destructive of that fertilizing power. That it is most important, therefore, to determine whether the fertilizing elements in the refuse are presented in such form as to be practically available for agriculture, either in the solid state or in the liquid form, so as to avoid the injurious consequences, and enormous waste of throwing away the sewage.

3. That the nature and value of the chemical constituents of the fæcal matter in sewage having long been known to physiologists and chemists, and admitted to contain all the elements necessary for the food of plants, the recent discussions as to its practical value for agriculture have not arisen from any doubts on that point; but from the uncertainty whether, being diluted in the large bodies of water employed for the drainage of towns, that value is realizable.

4. That chemical research has not yet arrived at any satisfactory method of economically arresting from solution the fertilizing ingredients in sewage, while the analyses of solid sewage manures, manufactured under various patents, show, that although for the most part possessing a certain low value, they do not justify the high prices at which they have been offered to the public; nor does there appear to be evidence of any agricultural results derived from their use, which will support such a view of their value.

5. That the manufacture from excrement of a dry portable manure, as practised at Paris, although realizing results of greater value, is applicable only where the cesspool system prevails, and leads to an aggravation of the nuisance of that system, which due regard for the public health would not tolerate.

6. That the separate system of drainage, frequently proposed as a solution of the sanitary and agricultural difficulties of the sewage question, would increase immensely the cost of drainage works ; would add to the sources of danger to the public health ; and would tend to a waste of fertilizing power.

7. That the practical experience obtained during many years at Edinburgh and Milan, has shown the great value of sewer water on grass lands, although applied in a state of great dilution ; while valuable experiments have shown the power of soils to remove from solution, and retain for vegetation, the fertilizing elements.

8. That notwithstanding the enormous quantities of sewage water which have been applied to the land at Edinburgh, the produce is said to be always in corresponding ratio to such quantity, and that the limits of quantity to be applied, and of produce to be realized, have not yet been ascertained.

9. That the precise value of the manure in a given quantity of sewer water, may be readily determined, and, therefore, that the corresponding quantity of water which must be applied to convey a certain required quantity of such manuring elements on to the land, may be at any time known.

10. That although such immense agricultural results have been obtained from irrigation with sewage water at Edinburgh, the method employed has given rise to much complaint of nuisance. That this arises for the most part from foul deposits in wide ditches, and from the large evaporating surfaces of the sewage constantly exposed in the channels of irrigation.

11. That all such sources of nuisance and danger are preventible, and should not be tolerated. That no ditches should be used, and that the sewage should be exposed only during the act of irrigation of each

portion of the land, when it would be immediately absorbed and deodorized by the soil.

12. That in order to avoid all further risk of injury to health, whether from discharge of the sewage into the rivers and streams, or from its application to the land, it appears desirable that the solid matter should in every case be separated from the liquid sewage at the outfall, and that a cheap portable manure should be manufactured therefrom for use in the immediate neighbourhood, as practised at Cheltenham. That it should be mixed with the ashes of the town, or such other deodorizing material as may be most suitable for application to the surrounding land, and prepared, if desirable, with other manuring ingredients for particular crops.

13. That it appears probable that such operation will in most places pay its own expenses, but that as some such measure is absolutely necessary for the public health, even though involving some expense, it should be the duty of Local Boards and other governing bodies to carry it out, just as much as arrangements devolving upon them for removal of dust or other refuse from the town. It should form, in fact, part of such service, and might be combined in the same contract.

14. That the liquid portion of the sewage, thus cleared of its solid matter, but still retaining its chief value as manure, might then be applied with benefit to the neighbouring lands in any quantity; but that all land upon which this method of application of the sewage is practised should, if not naturally porous, be artificially drained; as the liquid, if allowed to become stagnant, would, as in common irrigation, be likely to engender disease in the neighbouring inhabitants, or in cattle exposed to its influence.

15. That the distribution of manures in the liquid state by the hose and jet, from a system of underground pipes on the land, has been found, by the experience of several years upon farms in England and Scotland, most advantageous, and that the outlay for such works is considered by eminent agriculturists, who have had experience of their benefits, as a very

profitable outlay, irrespective altogether of the question of *sewage* distribution.

16. That although the adoption of the same system at Rugby, and other places, for the distribution of liquid sewage, has been found decidedly successful, the great Edinburgh results are not attainable by this method, unless conjoined with more ample and ready means for getting much larger quantities of sewage on a given area, in less time and with less labour and expense than can be done with the hose.

17. That upon grass lands, for which the application is best adapted, these larger quantities of the liquid sewage, deprived of its grosser particles, may be economically distributed, especially upon the lower levels, by a combination of the underground pipe system with the subsidiary open irrigation by small contour gutters, practised by Mr. Bickford.

18. That this work, being of a commercial or speculative nature, and not so much required for the safety of the public health, would fall rather within the province of local companies or proprietors than of the local authorities, and to those parties all facilities should be granted for carrying it out.

19. That the solid sewage manure, prepared and deodorized as above proposed, may be anywhere used, and any quantity of the liquid applied on absorbent or properly drained land, without any risk of injury to health, and without any of the offensiveness constantly experienced from farmyard and other solid manures applied as top-dressings.

20. That in any neighbourhoods, however, where no opportunity exists for this beneficial irrigation, the liquid sewage, before being discharged into rivers or streams, should, after separation of the solid matter, be treated with lime or other deodorizing and precipitating agents; a duty which should devolve upon the Local Board or other governing body, as a precaution in which the public health is materially concerned.

Lastly—That it is an object of immense public concern that the poisonous accumulations of our towns, now fast becoming the sources of pollution of our rivers and streams, should without delay be

rendered powerless for further mischief, and applied, as Nature's law demands, for reproductive uses. That by this means the greatest sanitary problem will be solved, and the greatest advancement of agricultural prosperity secured.

In drawing this Report to a close, I venture to express a hope that the attention I have been enabled to give to the subject may have added some little to our information; but impressed with its great importance and its difficulties—extending as it does into so many branches of inquiry—I feel strongly my own inability to do justice to it. It is a subject of study not for engineers alone, but for agriculturists, physiologists, and chemists of the highest attainments and experience.

I have the honor to be,
Sir,
Your very obedient servant,
HENRY AUSTIN,
Chief Superintending Inspector.

Whitehall, March 1857.

Postscript.—The examinations were made for this Report, and the particulars embodied therein were noted down, many months ago. The subject, however, having become daily more pressing and important, especially in relation to the metropolitan drainage, the Sewage Commission was appointed before my ordinary duties would permit of the entire Report being put into shape. The want of further investigation upon many points, which I have so strongly felt, will, I trust, now be supplied; and the bearings of the whole question upon the case of the metropolis, which, of course, have not come under my consideration, will now, I hope, be thoroughly investigated.

APPENDIX A.

List of Patents granted for Deodorizing and Preparing Manure from Fæcal Matters and Sewage.

Estienne, Lewis James Armand; 1802, January 9.—Converting or reducing human excrement into a powder divested of all nauseous smell, preserving at the same time its fertilizing properties in rendering land infinitely more productive and vegetative than any other manure hitherto discovered.

Poittevin, Joseph Henri Jerome; 1835, July 17.—Powder which is applicable to the purposes of disinfecting night soil and certain other matters, and facilitating the producing of manure.

Albert, Dominic Frick; 1842, August 10.—A new combination of materials for the purpose of manufacturing a manuring powder.

Buisson, Michel Antoine Bertin Burin du; 1845, June 23.—New and improved methods for the distillation of bituminous schistus and other bituminous substances, as well as for the purification, rectification, and preparation necessary for the employment of the productions obtained by such distillation for various useful purposes.

Higgs, William; 1846, April 28.—The means of collecting the contents of sewers and drains in cities, towns, and villages, and for treating chemically the same, and for applying such contents, when so treated, to agricultural and other useful purposes.

Brown, Edward; 1847, February 20.—Certain carbonic compounds formed of earth, vegetable, animal, and mineral rubbish, fæcal substances, the waste of manufactories, and certain acids and alkalies, which compounds are applicable as manures.

Adams, William Bridges, and Richardson, Robert; 1847, May 24.—Certain improvements in the construction of railways, and of engines and carriages used thereon; and also in transport and storage arrangements for the conveyance, management, and preservation of perishable articles.

Ellerman, Charles Frederick; 1847, October 7.—Certain processes or methods of rendering fæculent, excremental,

and other matters inodorous and disinfecting, and also of retarding the putrefaction of animal and vegetable substances, and certain chemical re-agents employed in the said processes or methods. (There is no Specification of this Patent enrolled).

BARKER, Edward; 1847, October 26.—Certain improvements in the preparation of manure.

MITCHELL, Benjamin; 1848, January 13.—Improvements in the manufacture of manure.

ROGERS, Jasper Wheeler; 1848, June 1.—Certain improved methods and machinery for the preparation of peat as a fuel, and in combination with certain substances as a compost or manure.

LEGRAS, Louis Napoleon; 1849, Nov. 30.—Improvements in the separation and disinfection of fæcal matters in the manufacture of manure, and in the apparatus employed therein.

TARLING, Henry James; 1850, March 7.—Improvements in the manufacture of fuel and manure, and deodorizing and disinfecting materials.

ANGELY, Paul d'; 1850, June 4.—Certain improvements in the construction of privies and urinals, and in apparatus and machinery for cleansing privies, cesspools, and other places, and in deodorizing the matter extracted therefrom, and rendering it available for agricultural purposes.

BROWNE, James Hamilton; 1850, October 10.—Improvements in the separation and disinfection of fæcal matters, and in the apparatus employed therein.

WICKSTEED, Thomas; 1851, February 24.—Improvements in the manufacture of manure, and in machinery to be used therein.

DOVER, Richard 851, October 16.—Improvements in treating sewage, in obtaining products therefrom, and combining such products with other matters.

STOTHERT, Henry; 1852, April 17.—Improvements in the manufacture of manure.

PETTITT, Edwin; 1852, October 1.—Improvements in the manufacture of ammoniacal salts and manures.

GILBEE, William Armand; 1852, October 6.—An improved mode of disinfecting putrified and fæcal matters, and converting fæcal matters into manure; also applicable to the disinfection of cesspools, drains, sewers, and other similar receptacles.

PERKES, Samuel; 1852, October 12.—Certain improvements in mines, buildings, and sewerage, for effecting sanitary purposes, and treating the produce therefrom.

BARDWELL, William; 1853, January 5.— Improvements in treating sewage waters and matters.

PINEL, Jacques Francisque; 1853, March 8.—Improvements in deodorizing sewage water and cesspools, and in manufacturing manures.

HERAPATH, Thornton John; 1853, March 15.—Improvements in treating sewage and in manufacturing manure therefrom.

DERING, George Edward; 1853, March 28.—Improvements in preserving or preventing decomposition in vegetable and animal substances and matters.

DIMSDALE, Thomas Isaac; 1853, May 20.—Improvements in disinfecting sewage or other fœtid matters, and in absorbing noxious gaseous exhalations.

MACPHERSON, Allan; 1853, June 20.—Improvements in disinfecting sewers or other drains, and in converting the contents thereof to useful purposes. (This invention did not proceed to the Great Seal.)

NEEDHAM, William, and KITE, James; 1853, July 14.—Improvements in machinery and apparatus for expressing liquid or moisture from substances.

SHAW, John, and STEINTHAL, Joseph; 1853, August 25.—An improved manufacture of artificial manure.

MANNING, James Alexander; 1853, November 29.—Improvements in the treatment of sewerage and other polluted liquids, and the products thereof.

MACPHERSON, Allan, 1853; December 10.—Improvements in disinfecting sewers or other drains, or depositories of fœtid matters or gases, and in converting the contents thereof to useful purposes.

SMITH, Robert Angus, and MCDOUGALL, Alexander; 1854, January 20.—Improvements in treating, deodorizing, and disinfecting sewage and other offensive matter, which said improvements are also applicable to deodorizing and disinfecting in general.

WICKSTEED, Thomas; 1854, January 26.—Improvements in the manufacture of sewage manure.

WICKSTEED, Thomas; 1854, January 26.—Improvements in the manufacture of sewage manure.

WICKSTEED, Thomas; 1854, January 26.—Improvements in the manufacture of sewage manure, and in apparatus for that purpose.

HERAPATH, Thornton John; 1854, March 17.—Improvements in the manufacture of manure from sewage, which

are also applicable to the preparation of other artificial manures.

MANNING, James Alexander; 1854, March 27.—Improvements in the treatment of sewerage.

KITE, James (Secundus); 1854, June 15.—Improvements in machinery and apparatus for expressing moisture from substances.

WHITE, William; 1854, October 12.—Improvements in the manufacture of manures.

LITTLETON, Thomas; 1854, December 1.—Improvements in separating gases from sewage and other waters for the manufacture of manure, and for supplying of steam engines.

ANDERSON, George; 1854, December 23.—Improvements in purifying sewers, and buildings or other places, from noxious vapours.

THEROULDE, François Alphonse; 1855, May 12.—Improvements in preserving animal substances.

MANNING, James Alexander; 1855, August 7.—Improvements in the treatment of sewerage.

COCHRANE, Alexander; 1856, January 1.—Improvements in collecting and distributing water, and alluvial deposits contained in sewage and other waters.

MANNING, James Alexander; 1856, July 5.—Improvements in the manufacture or production of manure.

WICKSTEED, Thomas; 1856, July 31.—Improvements in separating sewage and other matters, from water or fluid mixed therewith.

WARRINER, George, 1856, August 25.—Improvements in compounds for preserving, deodorizing, and fertilizing.

CHODZKO, Stanislas; 1856, September 15.—Improvements in the manufacture of manure, and the apparatus employed therein.

APPENDIX B.

EXAMINATION of the COMPARATIVE DEODORIZING powers of PEAT CHARCOAL and BOGHEAD COKE.

Charcoal is obtained when any organic body is imperfectly burned in closed vessels, that is, without the admission of sufficient air to effect its entire combustion. Different organic bodies, therefore, yield different kinds of charcoal; we have, thus, animal charcoals, obtained by the carbonization of bones and of blood, the charcoal of different kinds of wood, the charcoal of peat and coke, the charcoal

from coals. Each of these species of charcoal have separate and distinct qualities, resulting from their physical constitution. They all agree in containing a certain amount of carbon; their difference results from the nature and amount of the ash or mineral constituents contained in the original body. This ash seems to divide the carbon, giving it a greater or less amount of porosity and surface.

The peculiar action of charcoal is due to the extent of its surface and the size of its pores. It has the power of absorbing and condensing within these pores many times its volume of different gases and vapours, and thus many bodies which have no power to enter into combination with each other in their gaseous state are so changed in their properties when simultaneously condensed within the pores of a charcoal, that the chemical force is brought into action, and a change of constitution is effected. In this way odorous gases are first condensed and then altered in constitution. Some charcoals have also the property of removing certain bodies from solutions; but the property of condensing gases and the property of removing substances from solutions belong to different species of charcoal. Peat charcoal has been found the most efficacious in condensing offensive odours, and bone charcoal to possess the greatest power of removing colouring and other organic matters from their solutions.

In the first instance, therefore, it was determined to examine the constitution of the boghead coke in comparison with peat charcoal, and animal charcoal derived from bones. The following table will show this comparison:—

	Per cent. of Carbon.	Per cent. of Ash.	Constituents of Ash.
Animal charcoal -	10·2	89·8	Phosphate and carbonate of lime.
Peat charcoal -	74·1	25·9	Silica, alumina, and carbonate of lime.
Boghead coke -	36·8	63·2	Chiefly silica.

From this preliminary examination it would be inferred that the properties of the boghead coke would approach more nearly to those of the bone charcoal than to those of the peat charcoal. The result will be found in the sequel.

One hundred parts of peat charcoal and of boghead coke were added separately to one thousand measures of sewer water in a state of putrefactive decomposition, and giving off offensive odours. After being stirred well together and allowed to subside they were filtered off; a slight diminution of odour was the result, but neither produced complete

deodorization of the sewer water. Fresh portions of the charcoals were added, until the whole of the sewer water was absorbed by the charcoal, but deodorization was by no means complete, and on heating the mass over a fire offensive effluvia were abundantly given off. This might have been anticipated. When portions of each kind of charcoal were sprinkled over the surface of the sewer waters, in vessels partly filled, the escape of all odour was entirely prevented. The peat charcoal, however, was speedily saturated with the fluid, and sank to the bottom of the vessel, where its deodorizing power was lost, while the powdered boghead coke floated for several weeks, and entirely prevented the escape of any odour.

Their relative power to condense gases was next determined.

A portion of each charcoal was heated, to expel any gases that might have been condensed by them, and weighed quantities introduced into tubes. Ammoniacal gas, passed through a tube containing quicklime to absorb any water, was then passed into the tubes containing the charcoal until it freely escaped from the outlet. The tubes were then again weighed. The peat charcoal absorbed 1·7, or nearly two per cent. of its own weight. The boghead coke absorbed 0·44, or scarcely one-half per cent. of its weight of dry ammoniacal gas. Dry sulphuretted hydrogen was then passed into the charcoals, which they condensed in about the same proportion, though to a less extent. As these are the principal gases which it is proposed to absorb, it may be inferred that peat charcoal is about four times more efficient as a deodorizer of atmospheres than the boghead coke.

The amount of matters separated from sewer waters by each charcoal was next examined.

Matters in suspension were allowed to subside, and 10,000 measures of the sewer water were passed through 1,000 parts by weight of the charcoals.

The Tottenham sewage was employed for this purpose; before filtration it held in solution 10·5 parts, of which 3·6 were organic and 6·9 mineral; after filtration through peat charcoal 12·5 parts, of which 3·1 were organic and 9·4 mineral; after filtration through boghead coke, 10·4 parts, of which 3·6 were organic and 6·8 mineral.

From this examination it would appear that neither had much power in separating matters in solution from sewer waters, while the peat charcoal actually yields up some of its soluble mineral constituents to the action of the water.

During the progress of these experiments, I noticed a curious property of the boghead coke in the state of powder. I have already mentioned the fact of its floating on the surface of a liquid; indeed, it is with great difficulty that it

can be made to mix with water. I was surprised to find the quantity of fluid covered by the boghead coke diminish more rapidly than that with which the peat charcoal was mixed, but which had sunk to the bottom. By another experiment I have satisfied myself that the boghead coke actually promotes the evaporation of water, on the top of which it is sprinkled, while it effectually condenses any odorous gases that would otherwise have escaped from the surface. From these premises we may draw the following conclusions :—

1. That boghead coke does possess the power of condensing odorous gases, to the extent of about one-fourth of that possessed by peat charcoal.

2. That neither boghead coke nor peat charcoal are perfectly efficient in deodorizing liquids when mixed with them.

3. That boghead coke is as good a filtering medium as peat charcoal, if desired to be used for that purpose.

4. That the boghead coke possesses the valuable property of floating on the surface of a liquid and effectually preventing the escape of odorous gases—a property which is not possessed by peat charcoal—while the fact of its promoting the evaporation of water would render it valuable in promoting the drying of deposits obtained from sewage for the purpose of forming manures.

LINDSEY BLYTH.

Laboratory, General Board of Health,
January 31st, 1857.

APPENDIX C.

LAYING OUT CATCH-MEADOWS.

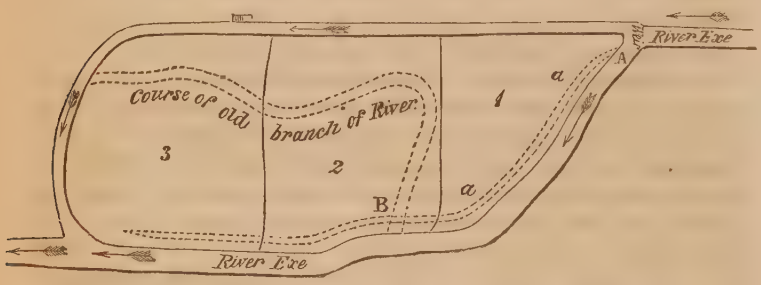
(From the *Journal of the Royal Agricultural Society of England*, vol. xiii., part 1.)

THE improved system of guttering, invented by Mr. Bickford, of Crediton, and of which I have made partial use in some water-meadows in the neighbourhood of Exeter, appears to me to possess great advantages, both in efficiency and economy, over that usually practised in this neighbourhood, and seems likely to be of great value if sufficiently made known.

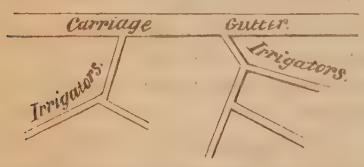
The meadows to which I refer are situated on the banks of the Exe, about two miles above Exeter, and lie between the river itself and the stream, which is taken out of it at Pynes Weir, for supplying the city with water. The waste water of this stream returns to the Exe immediately below the meadows, so as completely to surround a space of about thirty acres. This space is divided into three meadows, of

which the highest has always been in my own occupation, while the two lower pieces have been let off. Till about seven years ago, they were occupied by my steward, and while he held them they were regularly watered; but they have lately been let on lease to a tenant who, for some reason with which I am unacquainted, has not availed himself of the means of irrigation which were at his command. The higher meadow, therefore, is the only one which has been watered of late years. Having now, however, taken the whole of them in hand, I proceeded last autumn to examine the condition of the lower meadows, in order to ascertain what was requisite to be done to supply them with water.

The nature of the ground will be most easily understood by reference to the subjoined diagram.



The water is, in the first place, brought into the higher marsh (No. 1) at A, a point a little below the weir, whence it is carried by means of a large gutter *a a* (3 feet wide and 2 feet deep) along the highest part of the land. From this gutter there are cut, at irregular distances, other and smaller gutters, which traverse the meadow in various directions. By stopping any of these gutters with earth at any point, the water is made to overflow, and thus irrigates whatever part of the land it is desired to benefit.



The carriage gutter *a a*, after passing through the meadow No. 1, enters the meadow No. 2., where it is carried by a wooden shoot B, over a hollow, which was formerly a branch of the river. This branch is now partially filled up, and its communication with the river is entirely cut off. It serves as a drain to carry off the surface water and the waste of the irrigation.

The marsh No. 2 is extremely irregular and undulating in its character, and cannot possibly be watered by a single carriage gutter. The main gutter *a a* is therefore divided into several branches, which diverge very widely from one

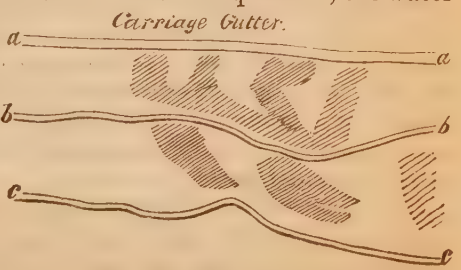
another after crossing the shoot B. The water in former times used to be brought into one or other of these branches by shutting it out of the others by means of wooden fenders, and it was then distributed over the marsh in the same manner as in the meadow No. 1. The carriage gutters, or some of them, were also continued into the marsh No. 3; but owing to the irregularity of the ground, and the great size of the carriers, it was impossible to water both marshes at the same time; and when it was intended to convey the stream into No. 3, it was necessary to stop the branch gutters in No. 2. I am informed by my steward that it usually took a whole day to bring the water properly over *either* of the marshes. I shall presently explain that, by the improved system, it can now be brought over *both* in about three hours.

The system of irrigation invented by Mr. Bickford is as follows:—

A carriage gutter is, in the first place, cut along the line of the highest ground. This gutter is laid out in the usual manner by means of a spirit level, an inclination being given to it according to the nature of the ground and the quantity of water which can be made available. Where it can be had, a fall of 2 inches in 4 land yards, or 1 in 396, is thought desirable, but a very much less rapid fall will do. The width of the carriage gutter should be about 1 foot, and the depth about 6 inches; but these dimensions are gradually diminished as the gutter approaches its termination, so that at last it dies into the ground.

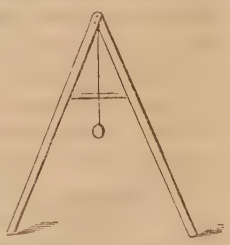
When the carriage gutter is filled, the water begins to overflow over the sides; and were the slope of the ground exactly uniform in all directions, the water would run equally over the whole; but as the slightest inequality would prevent this, and would cause it to run in streams along the lowest parts, a series of smaller gutters are cut below and in the same direction with the carriage gutter, one below the other, which catch the water, and again distribute it evenly over the land.

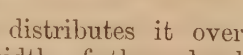
Thus, supposing *a a* to be a carriage gutter running along the ridge of a piece of land full of small inequalities, the water instead of making its way along the hollows to the bottom of the field, is caught by the small gutter *b b*, which is so cut as to be nearly level, and without any fall at all from one end to the other. The water must, therefore, accumulate in the gutter



b b till it is quite full, when it begins to overflow at all points, and is again caught by the next level gutter *c c*, and so on till it reaches the drain at the bottom of the field.

It is in the formation and use of these level catch-gutters that the peculiar merit of Mr. Bickford's system consists. They, as well as the carriage gutters, are cut with a plough, which will presently be described; but in laying them out the use of the spirit level is superseded by an instrument of great simplicity and convenience. It is of the form of the letter A, and stands about 5 feet high the feet being 4 feet apart. A plumb line is suspended from the apex, and a notch is made in the centre of the cross-piece, so that when the two feet stand on the same level the plumb-line crosses the notch. The gutterer rests one of the feet of the instrument on the ground, and, using this as a pivot, turns the whole round like a pair of compasses, till he finds by the plumb-line that the two feet stand even; then marking the spot where the first foot stood, and using the second foot as the pivot, he finds the next level spot in the same manner, and so proceeds with great rapidity to trace out a level line throughout the field, marking each spot as he goes on; then taking the plough, he cuts a furrow along the line so marked out, which is, consequently, a perfectly level gutter. At points where the ground changes so as to render it impossible to get a level, a stop is put in the gutter, and a fresh level taken for its continuation. Thus, when the higher part of the gutter is full, the water runs over the land alongside of it, and also flows over the stop *a* into the lower part of the gutter, which distributes it over another portion of the field. The width of these level gutters is usually about 4 inches, and the depth nearly the same, the object being to economise both water and space as much as possible. It is obvious that a number of deep and broad seams, following the tortuous course which must be pursued in search of a level, would take up a great deal of land, besides interposing serious obstacles to hay-making, and proving otherwise inconvenient; they have, moreover, the disadvantage of retaining a great deal of water, which filters away through the bottom of them, depositing the most valuable part of the sediment it contains in the gutter, instead of distributing it over the field; besides, they delay the process of irrigation, which it is desirable to render as rapid as possible; and, where only a small quantity of water can be obtained, they defeat the irrigation altogether;



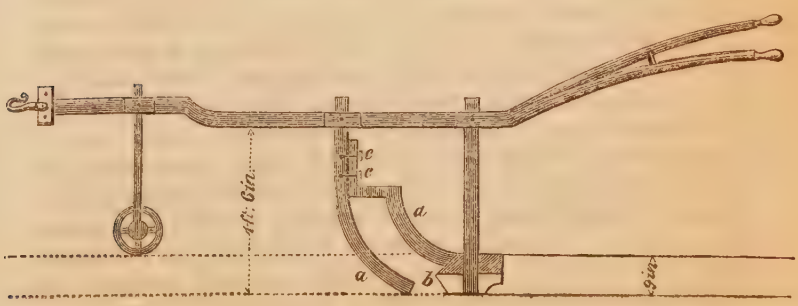


and, lastly, they are more expensive to clean out when the time comes for preparing the land for watering. I am told that 2*s.* an acre is a moderate charge for cleaning out the old class of gutters, while the small level gutters may be cut afresh, when once the levels have been marked out, for just half that sum.

According to the explanation which I have now given, it will appear that the field is watered by stages; and were the system always followed in the manner I have described, the upper stage would always receive the benefit of the greatest amount of sediment when the river is foul after the rains; the second stage would be the next in favour, and so on, till the lowest part of the field received nothing but water in almost a filtered state. This disadvantage is obviated by the use of feeders or small transverse gutters, which run from the carriage gutter at the top across all the level gutters to the lowest of all. By stops in the proper places, the water can thus be conveyed directly from the carrier to any one of the catch-gutters without passing over the intervening land at all, and the lowest portion of the field may be watered first, and the highest last, if desired.

One more contrivance deserves to be noticed, though it is not peculiar to Mr. Bickford's system. In some cases it is desired to carry the water along a level line on the hill-side, without any fall at all. In order to make it flow, an occasional sharp turn is made, and the gutter continued at lower level. The fall thus caused communicates motion to the water along the preceding level gutter.

The plough with which the gutters are cut was exhibited at the Exeter meeting in 1850, by Mr. Thomas Moore, of Newton St. Cyres, and was, on that occasion, "commended" by the judges. A drawing of it is annexed. The two



knives *a a* cut a slice of the proper width, and the furrow-slice *b* scoops it out at the proper depth. The width of the slice is regulated by the screws *c c* which attach the right-hand knife to the implement; the left-hand knife is fixed, but the right-hand knife may be taken off by unscrewing it at *c c*. When put on, it may either be screwed close up, or a space may be left, so as to leave 6 inches between the knives; when screwed up close, the distance is 4 inches. In cutting a carriage gutter of a foot wide, it is necessary to go over the line twice. The price of the implement is 3*l*.

Having thus described the chief points in Mr. Bickford's system, I must add, what will perhaps be obvious, that its success much depends upon the judgment with which it is applied. Although the level catch-gutters can be laid out with mechanical accuracy by any intelligent person capable of using the plumb-line, yet, in order to give the best direction both to them and to the carriers, a practised eye is an essential requisite. The gutterers in this part of the country are quick in perceiving irregularities in the ground which would escape an ordinary observer, and can tell, almost at a glance, in what direction the gutters can be laid out so as to economise both ground and labour. They use the plumb-line rather to correct and verify than to guide the formation of the levels. When a water-meadow has once been laid out, there is no difficulty in cutting fresh gutters with the plough along the course indicated by the original ones, and it is recommended that this should be done every season, in preference to cleaning out the old gutters. The expense is not greater; the earth which comes out of the new furrow is used for filling the old one by its side, and the growth of coarse grasses along the gutters is thus prevented. In the first laying out of a meadow, however, the services of a practised gutterer should be put in requisition. The expense—an important question—is very moderate. In the work which I have been executing in my own meadows, I have employed Mr. Edward Ellis, of Newton St. Cyres, whose charge for "irrigating, cutting, and regulating 23 acres of marsh land," amounts only to 8*l*. 12*s*. 6*d*. or 7*s*. 6*d*. per acre. In addition to this, I paid 3*l*. 8*s*. 6*d*. to my own labourers employed in assisting Mr. Ellis, and I lent one of my own horses for the work. The plough was the property of Mr. Ellis.

It will be observed that, in these meadows, the carriage gutters had already been partially laid out; this, of course, saved a great deal of labour. The ground is, however, remarkably uneven, and the expense of the level gutters was consequently greater than would usually be the case.

Some new carriage gutters were cut, and a good deal of labour was bestowed on reducing the size of the old gutters, which have been diminished from 3 feet wide by 2 feet deep to 1 foot 9 inches wide by 1 foot deep. (They are still larger than is desirable.) Taking all these circumstances into consideration, I am of opinion that water-meadows similarly situated might be completely laid out at an expense not exceeding 1*l.* per acre. The annual expense of cleaning them, or of cutting fresh gutters by the side of the old ones, may be taken at 1*s.* an acre; and for these very low sums the land may be as fully, and more fully, benefited than by the old system, under which the cost could not be taken at less than 4*l.* or 5*l.* an acre; while the annual expense of cleaning the gutters amounted to fully 2*s.* an acre, or double the sum now required.

As an instance of the advantage of this system of watering, where only a limited supply of water can be obtained, I may mention that my steward has recently availed himself of Mr. Ellis's services in laying out two meadows of about 15 acres in extent, which are watered from a pond estimated to contain something like 50 hogsheads. In this case the water is carried along a level ridge by a carriage gutter, in which two breaks and sharp turns (as above described) occur. When it is desired to water the first part of the meadow, a stop is put at the first break, and the water overflows, and is caught by the level gutters below.

To water the second part of the meadow, the stop is put at the second break, and the water, therefore, runs out of the first part of the carriage gutter, and fills the second till it overflows.

To water the third part, the stops are removed, and the water runs, without overflowing, into the third portion of the carrier, whence it is distributed over the ground below.

STAFFORD H. NORTHCOTE.

Pynes, Exeter, June 29, 1852.

APPENDIX D.

LIST of OWNERS and OCCUPIERS of FARMS* on which Works are established for the Application of Liquid Manure by Pipes and Jet.

In England and Wales.

J. J. Mechi, Esq. - -	Tiptree.
J. Daw, Esq. - -	Exeter.
Earl of Essex - -	Watford.
R. Neilson, Esq. - -	Liverpool.
H. Littledale, Esq. -	Birkenhead.
Duke of Sutherland -	Trentham.
Lord Grey - - -	Alnwick.
Rev. R. W. Bosamquet -	,,
F. Stainer, Esq. - -	Staffordshire.
Sir M. Cholmeley -	Lincolnshire.
J. Wheble, Esq. - -	Near Reading, Berkshire.
— Naylor, Esq. - -	Near Welshpool, Glamorganshire.
— Romilly, Esq. - -	Near Cardiff, Montgomeryshire.

In Scotland.

P. W. Kennedy, Esq. -	Ayrshire.
A. B. Telfer, Esq. - -	,,
A. Ralston, Esq. - -	,,
Marquis of Ailsa - -	,, Castle hill, and Newark.
J. Kennedy, Esq. - -	Dumfrieshire.
F. McConnell, Esq. -	,,
D. Baird, Esq. - -	,,
N. Malcolm, Esq. - -	Argyleshire.
Duke of Argyle - -	,,
Lord Strathallan - -	Perthshire.
Robert Harvey, Esq. -	Glasgow.

In Ireland.

Model Farm - -	Glasnevin.
J. Fagan, Esq. - -	Turvey House.

* For the names in this list of the places which I have not visited, I am chiefly indebted to Mr. Young, engineer, of Ayr, by whom much of this work has been executed.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.